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ABSTRACT

This guide outlines an Option Y course, which has seven learner objectives geared to providing students with an introduction to the concerns and methods of statistics and equipping pupils to deal with the many statistical matters of importance in society. Topics included in the course are graphs and charts, collection and organization of data, measures of central tandency and dispersion, uses and misuses of statistics, frequency distributions, correlation, and regression. The teacher's commentary and masters for worksheets, transparencies, quizzes, and tests provided are based on the text book "Statistics and Probability in Modern Life" by Joseph Newmark, but many of the ideas and resource suggestions could be applied to other texts. This document encourages the use by students of hand calculators in performing the many necessary calculations. It is also suggested that organization skills be taught to the class. (MP)

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STATISTICS MANUAL

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STATISTICS MANUAL

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Table of Contents

Introduction

Statistics Course Objectives T1
A Sample Statistics Course T3

A Sample Statistics Course: Course Outline T6

Teacher's Commentary

Introduction T7
Chapter 1 . . . . T7
Chapter 2 . . . . T10
Chapter 3 and Chapter 4 . . . . T20
Chapter 9 . . . . T35

Masters for Worksheets, Transparencies, Quizzes, and Tests

Introduction T43
Chapter 1 . . . . T44
Chapter 2 . . . . T48
Chapters 3 and 4 . . . . T77
Chapter 9 . . . . T129

Answer Keys

Worksheet Answer Key T163
Quizzes and Tests Answer Key T193

INTRODUCTION

Statistics Course Objectives

As stated in the Mathematics Program Guide, Statistics, an Option Y course, is intended "to provide students with an introduction to the concerns and methods of statistics. It will equip them to deal with the many statistical matters of importance to society. Topics included in this course are graphs and charts, collection and organization of data, measures of central tendency and dispersion, uses and misuses of statistics, frequency distributions, correlation and regression."

Learner Objectives

The Department of Education provides seven learner objectives for this course. These objectives indicate the minimum course content for a statistics course. The student:

- Distinguishes between descriptive and inferential statistics.
- Constructs frequency distributions and displays the data using various graphical methods.
- Computes percentile and percentile ranks.
- Calculates and compares the mean, the median, and the mode.
- Describes how scores are dispersed about the center by computing range, average deviation, variance, and standard deviation.
- Calculates linear correlation coefficients and draws scattergrams.
- Predicts one variable's value, knowing another, by using the least squares regression equation and line.

Problem-Solving Goals

In addition to the learner objectives, the development of problem-solving skills is an objective of this course. Problem solving in this context refers to finding an appropriate response to a new situation or to a question which does not have an obvious answer; that is, getting the answer involves more than an act of simple memory or the application of a familiar algorithm. The problem solver must analyze the situation and determine the best strategy among a choice of many.

Problem-solving skills do not necessarily result incidentally from exposure. Rather, these strategies should be taught for maximum results. The attitude of the teacher toward problem solving is an important factor. Some teaching suggestions for problem solving are:

- To encourage discussion of problems and alternatives. This is the key to the course. Every problem can be expanded if students indicate an interest.

- To ask leading questions instead of giving answers. What would happen if...? Suppose we change...?

- To emphasize and provide the time needed for thinking about the problem. True problem solving requires time to think. If the "answer" is obvious, then there was no problem.

- To emphasize the process or strategies involved. In this course, the goal is to think through a problem. Finding a solution to the problem is just one result of this thought process. These problem-solving techniques are applicable in many areas.

- To find problem solving a fun, challenging, and rewarding experience for yourself and your students.

Teacher-directed discussion is an important aspect of this course. Discussion gives students the opportunity to develop language and communication skills. For example, vocabulary can be expanded when unfamiliar words are defined. Also, teachers and students gain insights into how a student thinks when the student describes strategies used or patterns observed in a problem.

Problem-Solving Skills

The following may be used as a teacher reference or as a basis for a class discussion. Resulting ideas can be added to this list of problem-solving skills that can be applied to the study of statistics.

1. Understanding the Problem

   --restate the problem
   --determine what is known
   --clarify the vocabulary, conditions, limits of the problem
   --determine the nature of the answer (e.g., how accurate?)

2. Devising a Plan

   --determine what information is needed
   --determine how information is to be obtained
   --look at alternative strategies and/or approaches
   --consider the consequences of each alternative

3. Carrying Out the Plan

   --collect data
   --organize data into tables or graphs (How is data best represented? Can data be easily and accurately read and interpreted?)
   --summarize and interpret data

4. Looking Back

   --Was the plan a good one?
   --Is the interpretation justified?
   --Is the result reasonable and/or accurate?
   --Has the problem been solved? The question answered?
   --Are there further implications?
   --Are there noticeable trends or patterns?
   --Can the information be used for forecasting?

Problem-solving strategies are incorporated throughout this course. In particular, specific problem-solving skills are included between the double arrows, <<.....>>, in the left margin of the teacher's commentary.

A Sample Statistics Course

Until recently statistics has been taught primarily to college students and highly-motivated high school seniors. Consequently, the number of available materials for teaching an Option Y course is very limited. This sample course is based on the textbook, Statistics and Probability in Modern Life by Joseph Newmark, published by Holt, Rinehart and Winston. Although the text was originally intended as a general introduction for college students, the Teacher's Commentary provided in this manual helps to adapt it for use at the high school level. The outline for the course follows this introduction.

Teacher's Commentary

In the teacher's commentary each lesson is described in more detail, new vocabulary is identified, comments are made including suggestions for emphasis and teaching strategies, and a suggested assignment is provided. In many cases the textbook lesson has been expanded and/or supplemented. Supplementary worksheets, sample quizzes and tests are also provided. Throughout the commentary teachers are referred to the State of Hawaii's Statistics Curriculum Guide for additional information, exercises, test items, and so on.

Lessons that are identified in the commentary were designed with a 40-minute class period in mind. However, student abilities will vary from class to class and one lesson will not necessarily be equivalent to one class period. Depending upon the class composition some assignments will take more than one day to complete. Both the lesson outlines and the suggested assignments should be considered flexible in order to meet the needs of the individual class.

Instructional Strategies

Creating frequency distributions, making graphs, finding standard deviations and correlation coefficients, and so on are often time-consuming tasks. Therefore, questions asked in quiz or test format must be judged carefully not only for their content, but also for the amount of effort required for solution. Two or three lengthy problems could take an entire period to solve. For this reason, the course tends to emphasize process- or computation-oriented problems on quizzes and concept-oriented questions on tests. This does not mean that quizzes and tests use one type of question exclusively. However, it does allow the teacher to formally evaluate the students' abilities in all areas. It also means, though, that some quizzes may take most of one class period. Because of the number and complexity of the formulas used in this course, the teacher may want to allow students to use their notebooks or a list of formulas during some of the exams.

The study of statistics requires students to perform many computations. These computations often involve large or "messy" numbers and can be quite complex. The emphasis of this course should not be on computation. Also, there is no need to spend large amounts of time performing these computations. THE USE OF HAND CALCULATORS IS ENCOURAGED. If possible, make school or department hand calculators available during class periods. Encourage students to bring their own calculators to class. Let students know they will be allowed to use calculators during quizzes and tests. Even if every student does not have a calculator, there are generally enough available so that sharing them during the period will satisfy everyone's needs.

Students will find the course much easier to follow if they organize their work. The use of a loose-leaf notebook should be strongly recommended if not required. Teachers should discuss organization skills with the students. The notebooks should be used to record assignments, to list definitions and formulas, and as a place to do homework assignments. Also, supplementary worksheets, quizzes, and tests should be included in the notebook as they are completed. Periodically students will be referred back to exercises completed at an earlier date. An organized notebook reduces the frustration of looking for the appropriate page.

Many of the assignments suggested throughout this course are intended as classwork. The problems are often lengthy. If a student has difficulty in the beginning of a problem he or she will be less likely to "give up" if the teacher or a classmate is there to offer help. It is often true that students learn more by working with and helping each other. This arrangement also provides the teacher with an opportunity to assess students' understanding of the material.

Additional Resources

The State of Hawaii Statistics Curriculum Guide includes exercises and Suggested Student Readings for each learner objective. The books, How to Lie with Statistics; Flaws and Fallacies in Statistical Thinking; Statistics: A Guide to the Unknown; and Statistics by Example: Exploring Data, include many of these assignments and readings and make excellent classroom resources. In many cases the content concerns real-life applications of statistical concepts and problems encountered when using these concepts. The books can be used in a number of different ways. One way involves assigning each student a project or reading from a specific book. Due dates can be staggered so that students can make timely presentations to the class. An alternative use involves supplementing the course with these articles and exercises. Other approaches use the books for extra credit assignments or to supplement the course material for some of the better students.

A SAMPLE STATISTICS COURSE

COURSE OUTLINE

Introduction: Reading the Textbook

Chapter 1: The Nature of Statistics

- Section 1.1: Choice of Actions Suggested by Statistical Studies
- 1.2: Statistics in Modern Life

Chapter 2: The Description of Sample Data

- Section 2.1: Frequency Distributions
- 2.2: Other Graphical Techniques

Chapter 3: Numerical Methods for Analyzing Data

Chapter 4: Percentiles and Z-Scores

- Section 4.1: Percentiles and Percentile Rank
- 3.1: Measures of Central Tendency
- 3.2: Measures of Variation
- 3.3: Computational Formula for Calculating the Variance
- *4.2: Z-Scores
- *3.4: Coding

Chapter 9: Correlation and Linear Regression

- Section 9.1: Scatter Diagrams
- 9.2: The Coefficient of Correlation
- 9.4: Linear Regression
- 9.5: The Method of Least Squares

* optional topics

TEACHER'S COMMENTARIES

INTRODUCTION

Reading the Textbook

Comments: On the first day of most high school courses, many organizational details must be addressed. As a result, students frequently do not accomplish much in class that day. The time, however, does not have to be "wasted." Once students have received their books and book receipts have been completed, they should begin Worksheet 1: Reading the Textbook.

Too often students don't understand the organization of their textbooks and don't know how to use them when they have difficulty with a problem. This worksheet introduces the text to them. It should be discussed in class and questions relative to the exercise should be asked:

- Why were you asked to do this worksheet?
- What do you think is the purpose of these exercises?

« USE RESOURCES »

This should be only the first of many times when the textbook is read and explored in class. Students should be referred to the appropriate section of their text when they do not remember a definition, a formula, and so on.

Suggested Assignment: Complete Worksheet 1 (in class)

Read pages 2-7 (students should be prepared to discuss the content of these pages during the next class period)

CHAPTER 1

Comments: Read T-3 in the Solutions Manual and pages 15-17 in the Department of Education's Statistics Curriculum Guide.

Lesson 1: The Nature of Statistics

Vocabulary: statistics, data, descriptive statistics, statistical inference, sample, population

Comments: The text is readable and students will benefit from reading it. Let them know you are serious when you give them a reading assignment. Ask questions about their homework reading assignment.

- What is statistics?
- Who uses it?
- What is data?
- What did H. G. Wells prophesize about statistics?
- What is misleading about the graph on page 7?

EXTEND TO REAL-LIFE SITUATIONS

Introduce descriptive statistics and statistical inference by having the students read the article "Get Ready to Stand Up and Be Counted" (Worksheet 2). Descriptive statistics is used to summarize the data from the 22-question short form. Methods of inferential statistics are applied to information provided on the 65-question long form. The concepts of population and sample can also be introduced at this time. Encourage students to comment on the methods used by the Census Bureau and the criticisms the Bureau has received. What procedures might be used in selecting the sample for the long form? What risks are involved?

An alternate method of introducing this topic is to show the films "We" and "Fact Finder for the Nation" produced by the Census Bureau/U.S. Department of Commerce. Both of these films are available free of charge from Film Services of Hawaii in Honolulu. (These films could be shown at a later date instead to reinforce the concepts and/or to continue the discussion.)

CLARIFY MEANING

Have the students identify whether descriptive statistics or statistical inference is used in different situations. They should also identify the population and, if statistical inference is used, the sample. An overhead transparency master is provided for this purpose.

Suggested Assignment: Read pages 8-11

QUIZ 1

Quiz 1 should be assigned at this time. Students are to find five examples of statistics in use in newspapers, in magazines, or on television. Using the form provided for the quiz, students should identify the type of statistics used, the population, the sample (if appropriate), and the source of the data. The quiz should be completed and turned in no more than one week from the date assigned.

Lesson 2: The Nature of Statistics (continued)

Vocabulary: bias

Comments: Ask students to share some of the uses of statistics that they have found with the rest of the class. Encourage discussion of whether or not the sources of data should be questioned.

EXTEND TO REAL-LIFE SITUATIONS

This is a good time to start a Statistics bulletin board display. As students bring in examples, the clippings can be placed on the bulletin board. The display can be added to or updated throughout the semester.

To reinforce the last class discussion on descriptive statistics and statistical inference complete exercise 2 on page 12 as a group.

The technique of sampling is very important in statistical inference. Explain to students that how a sample is chosen is very important. There are good samples and bad samples.

Example: Consider the following situations.

a. Your school is trying to collect data on the ethnic background of its students. This statistics class is used as a sample.

b. The federal government is trying to collect data on the ethnic background of students in the United States. This statistics class is used as a sample.

《 BRAINSTORM ON GIVEN INFORMATION, IMMEDIATE INFERENCES, ASSUMPTIONS 》

In which case will the results be more realistic? Is this statistics class a better sample for one situation than the other? How could a more reliable sample be selected for the second case? Using this class as the sample when inferring things about the entire U.S. student population will provide very BIASED results. (The results in the school example will also be biased, but to a lesser extent. Why? Can the class describe a better way to sample the student population at their school?)

《 USE AND MISUSE OF STATISTICS 》

Statistics are not always used properly. As seen above, selecting the wrong sample can make results worthless. Also, advertisers often use statistics in such a way that the consumer is misled. Advertisers can select a biased sample to get the results they want or, often, they will compare two things without saying what is being compared. ("People who use Brand X toothpaste have 50% fewer cavities." Fifty percent fewer than who?) Do Exercise 1 on page 11 orally as a class.

Suggested Assignment: Pages 11-12: Exercises 1, 3, 7-11

Lesson 3: The Nature of Statistics (continued)

Comments: Discuss any questions students have concerning the exercises on pages 11-12. Be sure to discuss Exercise 7.

Ask students to share some of the statistical uses they have found for their quiz.

The remainder of this period should be used as a question-answer session and as a work period.

Suggested Assignment: Mastery Tests, pages 13-15: Form A: 1-3, 5
Form B: 1-3, 6-9

CHAPTER 2

Comments: Read T-4 in the Solutions Manual and pages 18-27 in the Department of Education's Statistics Curriculum Guide.

Lesson 1: Introduction to Frequency Distributions

Vocabulary: random sample, frequency distribution, tally, frequency

Comments: Have the students read pages 16-19 and then discuss them in class. Ask the students which table (table 2.1 or table 2.2) is easier to read. What new information is provided by the distribution in table 2.2? Point out that the data is in rank order and the table should always have a title.

Ask everyone to look at exercise 1 on page 24. What information is needed before the data can be grouped into a frequency distribution? (The values of the largest and smallest pieces of data.)

« ORGANIZE DATA INTO A TABLE »

When tallying data in a frequency distribution some students will be tempted to count the frequency for each data value separately. For example, given a list of 200 integers between 0 and 20 some students will first count all the '1's, then count all the '2's, then the '3's, and so on. With this method students often lose count or their eyes skip over a number without seeing it. Discourage the use of this method.

Encourage the students to tally each piece of data as they come across it. For example, the raw data may be presented in a table with the first row reading

"5 3 1 5 2 4 3"

First one tally mark should be placed next to the 5, then one next to the 3, the 1, another one next to the 5, and so on.

Students may find it easier to complete the tally by working in pairs. One student can read the data values while the other one records it.

Suggested Assignment: Worksheet 1 (all except columns 4, 5, and 6 of problems 1 and 2; these will be done later)

Lesson 2: Frequency Distributions (continued)

Comments: Discuss the results of Worksheet 1, exercise 2. Which five letters occurred most frequently? Which five occurred least frequently? Ask the students how they think the results from this paragraph compare to the actual frequency of letters used in the English language. How might cryptographers use this type of information? Would the results vary if a different language was used?

« EXTEND THE PROBLEM »

APPLY PROCESS USED TO SOLVE SIMILAR PROBLEMS

In Worksheet 2 the students use information about the frequencies of letters in the English language to decode a message. Hints are given. Students who finish early or who enjoy this challenge can be encouraged to create a new code for a new message. The cryptograms can be placed on the bulletin board for other students to solve. Another alternative is for the teacher to provide these students with a more difficult cryptogram (without clues).

The remainder of this period should be used as a work period to solve the cryptogram.

Suggested Assignment: Worksheet 2

Read page 20 and the first two paragraphs on page 21

Lesson 3: Relative Frequency

Vocabulary: cumulative frequency (c.f.), relative frequency (r.f.), cumulative percent (c%)

Comments: Ask the students to explain the formula:

$$\text{Relative frequency} = \frac{f_i}{n}$$

Have them look at Table 2.3 on page 20 and answer questions similar to the following:

- What is f_2?
- What is f_4?
- If $f_i = 12$, what is i?
- What is the value of n?

CALCULATORS

Although the book has given the relative frequencies in Table 2.3 in fraction form it is often seen in decimal notation. Have the students convert these relative frequencies into decimals. The use of calculators should be encouraged.

Be sure the students note that the sum of all of the relative frequencies equals one. Can they explain why?

CLARIFY MEANING

Have the students complete the relative frequency column (column 4) on Problem 1, Worksheet 1. A transparency is provided for the teacher to help get them started. Then use the transparency to introduce the concepts of cumulative frequency and cumulative percent. These ideas will be extended in the graphing section when ogives are introduced. The cumulative frequency indicates how many observations have a value equal to or less than the value in column one. Cumulative percent indicates the percent of observations equal to or less than the value in column one.

Columns 4, 5, and 6 should be completed as follows:

10	.083*	08.3*
20	.083*	16.7*
35	.125	29.2*
48	.108*	40.0
60	.100	50.0
69	.075	57.5
81	.100	67.5
90	.075	75.0
106	.133*	88.3*
120	.117*	100.0

*Numbers have been rounded

Be sure to point out that cumulative percent can be computed a number of ways. One method is to divide the cumulative frequency by the number of observations and then multiply this result by 100 ($c\% = c.f./n \times 100$). Another method is to find the sum of relative frequencies equal to or less than the value in column one and multiply by 100. Using this method the cumulative percent may not have a final value of 100% due to rounding; however, the difference should be very small.

Suggested Assignment: Complete Worksheet 1, Problem 2

Page 27, Exercise 11 (In Part A do a 6-column frequency distribution only.)

Lesson 4: Grouped Data Frequency Distribution

Vocabulary: class mark, upper limit, lower limit

Comments: Compare Table 2.2 and Table 2.3 on pages 19 and 20. Be sure that students understand how the age intervals were selected and how the class mark for each interval is calculated. (The class mark is important later in the sections on measures of central tendency and measures of variation.) Note that the class mark is actually the average of the upper and lower limits of the interval:

« STUDY TABLES »

$$\text{Class mark} = \frac{\text{lower limit} + \text{upper limit}}{2}$$

Also note the last *Comment* on page 20. The author states that the first and last class intervals do not necessarily have to be equal in size to the other class intervals. For ease in grading and in comparison of papers the teacher may want to standardize how the intervals are set up. In a frequency distribution students may have 1) all class intervals equal, 2) the first class interval larger by "x" units, or 3) the last class interval larger by "x" units. In the first case Table 2.3 would be modified to have 11 class intervals (class number 10: 41-43 and class number 11: 44-46). In the second case the intervals would be 14-17, 18-20, 21-23, and so on.

• Show the transparency for a frequency distribution of Hourly Salaries for Students' Part-time Jobs. Have the students calculate the class mark for each interval. Ask someone to come forward to complete the tally. Encourage discussion of why there are problems completing the table. (The upper limit of one interval equals the lower limit of the next interval. A data item should belong in no more than one class interval.)

《 CLARIFY MEANING OF TABLE 》

Explain that if the low score in a distribution is 19, the first class interval does not have to begin with 19. It might start with a lower value (e.g., 18-23). Similarly, if the last class interval is 58-63, the highest score does not necessarily have a value of 63. The interval is listed with the higher value to maintain uniformity in class size.

Note: To find the class size of a distribution the author first finds the range of the distribution and then divides by the number of classes desired. The result is rounded to the nearest integer value. Students should realize that rounding this answer might affect the final outcome of number of classes. If 10 classes were desired, the rounding of the class size may result in a 9 or 11 class distribution.

Suggested Assignment: Worksheet 3

Lesson 5: Grouped Data Frequency Distributions (continued)

Comments: The number of classes used in a frequency distribution is not a fixed number. Among other things the number of classes is often dependent upon the degree of accuracy desired and the number of scores in the distribution.

Use the transparency provided and the data in Table 2.2 (page 19) to construct two more frequency distributions for the age at which women married. The first one should have five intervals and the second should have fifteen.

《 ANALYZE TABLES 》

Compare the four frequency distributions (Tables 2.2 and 2.3 and the two on the transparency) and discuss advantages and disadvantages of reducing the number of intervals in a distribution.

Rule of Thumb: In general, the number of class intervals, x, should be $6 \le x \le 15$.

Students should be given some flexibility in deciding how many class intervals to use in a distribution as long as their procedures are correct and the number of class intervals is "reasonable."

Suggested Assignment: Pages 24-25, #2-5 (frequency distributions only--use same column headings as Table 2.3)

Lesson 6: Grouped Data Frequency Distributions (continued)

Comments: This period should be used as a question-answer session and as a work period.

Suggested Assignment: Pages 25-27, #6, 7, 9, and 10 (omit parts concerning histograms)

QUIZ 1 Anytime after Lesson 6

Lesson 7: The Histogram

Vocabulary: histogram, class boundaries

Comments: Read and discuss the first four paragraphs on histograms with the class (pages 21-22). Make sure the students notice that the frequency scale is marked in equal intervals and that the scale starts at zero. Ask them to explain the break (—∧—) in the horizontal axis. When is it necessary to show a break on the axis? Point out that each axis of a histogram is labelled and the histogram itself should have a title.

IDENTIFY KEY ELEMENTS

A histogram represents continuous data. That is why the rectangles are adjacent to each other. Each class has lower and upper class boundaries. A class boundary is the midpoint of the upper limit of one class and the lower limit of the next class. The class boundaries define the true limits of each interval. Data which lies between these true limits will be in the given class interval when rounded. The class boundaries for the ages in Table 2.3 are actually 13.5-16.5 for class 1, 16.5-19.5 for class 2, and so on. It is not uncommon to use the class boundaries to mark the horizontal axis. (Use transparency provided to show this.) The difference between the class boundaries of an interval equals the width of that interval. Example: 22.5 - 19.5 = 3, therefore the interval width equals three.

READ AND INTERPRET GRAPHS

The same transparency shows the histogram represented a third way. Ask the students to look at the original histogram and tell you how many of the women were between 14 and 19 years of age (28). How is this shown on the third histogram? Why does the rectangle only have a height of 14? The students should recognize that the new rectangle has twice the width of the old rectangles. Since the area of each rectangle is proportional to the relative frequency the picture has been drawn correctly. However, the students should realize that people are often misled when histograms are drawn like this. It is preferable to have all rectangles of equal width.

Notice that in the first two histograms class interval 10 has a different width than the other intervals. It is possible to keep the intervals equal by adding an eleventh class (i.e., class 10: 41-43 with zero frequency and class 11: 44-46 with a frequency of 1).

Suggested Assignment: Read pages 22-24

Pages 24-25, #2-6 (frequency distributions have been completed during earlier assignments)

Lesson 8: The Histogram (continued)

Comments: Do problem 13 in class. Be sure students understand precisely what is meant by above, between, below or above, and so on.

The rest of the class should be used as a question-answer period and as a work period. After students have had a chance to complete exercise 7, be sure to compare and discuss the histograms constructed.

Suggested Assignment: Pages 26-27, #7-12 (frequency distributions for most problems were completed earlier)

QUIZ 2 Anytime after Lesson 8

Lesson 9: Computation Review

Comments: Constructing circle graphs requires many different computations. Fractions must often be converted to decimals, decimal numbers must be multiplied, decimals must be written as percents and percents written as decimals. Before beginning the actual construction of circle graphs these computation skills should be reviewed. Worksheet 4 provides exercises in these areas.

IS ANSWER WITHIN REASON?

Be sure to emphasize reasonableness of answers. For example, when multiplying .3 x 360, is 1080 a reasonable answer? No, the answer should be less than 360. The decimal has been omitted; the correct answer is 108.0.

Suggested Assignment: Worksheet 4

Lesson 10: Interpreting Circle Charts

Vocabulary: circle chart, pie chart

Comments: Have the students examine the pie charts on page 28. Ask questions such as:

- What part of the 1969 budget came from excise taxes?
- What part of the 1976 budget was spent on national defense?
- In 1969, which was larger: the amount received from corporation income taxes or the amount given as grants to states localities?
- Was more money received from individual income taxes in 1969 or 1976?

Make sure students realize why the last question cannot be answered. The total amount of money for each year is different so the percents cannot be compared. Ask them why the third question can be answered.

《STATE CONDITIONS GIVEN》

Ask the students to compare histograms and pie charts. What type of data is best suited to these graphs? They should realize that histograms represent continuous data and circle graphs represent data from one point in time. Also, circle graphs take one item and show how that item is subdivided and how the pieces compare to each other.

《SUMMARIZE AND INTERPRET DATA》

Use the transparency provided to discuss Example 2 on page 32. The percent of oil in reserve in Mexico has been deliberately left off the transparency. Have the students determine what value belongs there. Does the pie chart itself tell how many barrels of oil are in reserve in the United States? What additional information is needed? If you assume, as the example states, that there are 130 billion barrels of oil in reserve in the western hemisphere can the amount in the U.S. now be determined?

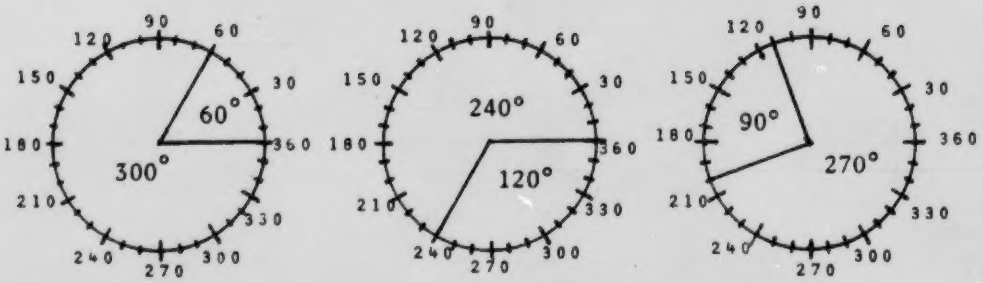
Suggested Assignment: Review Example 2, page 32

Page 40, #4-5

Lesson 11: Constructing Circle Charts

Comments: Since the only prerequisite to this course is Core Algebra, it is possible that many students will need to learn about circles. This should be reviewed before students do the computation involved in constructing a pie chart.

Use Transparency A to demonstrate the 360° of a circle and how an angle in a circle is measured.



Angles similar to the ones above should be discussed.

Use Transparency B to show how a circle graph can be drawn if the number of degrees is known. Be sure to label the pieces!

PROTRACTOR NEEDED

Transparency C should be used only after the students understand how a circle is divided into 360° and how to measure central angles in a circle. On this transparency the degrees are not marked and a protractor must be used. A clear plastic one works very well on the overhead. (If protractors are not available have the students estimate degrees on the circle by first finding the approximate locations of 180°, 90°, and 270°. The circle can be further subdivided by 10°, 30°, and/or 45°.)

Suggested Assignment: Worksheet 5

Read pages 27-32

Lesson 12: Circle Charts (continued)

Comments: Ask the students what information is necessary to construct a circle graph from "scratch," that is, when given just the raw data. They should realize from the reading that the percentage of total and the central angle measurement for each item must be computed.

Ask the students how they would find the percentage and central angle measurement for the following situation:

« OUTLINE APPROACH »

> Companies are required by law to provide the government with an ethnic breakdown of their employees. Quali-Products has a staff of 72 people. Eighteen of them are of Japanese ancestry.

Encourage discussion of the different approaches that can be used to compute these figures.

Use the transparency provided to illustrate the steps necessary to construct a circle graph. Indicate that organizing the data in a table often makes the work easier. Ask them why the middle

«CHECK RESULT AND PROCESS» column is labeled "Relative Frequency." Remind students that each part of the graph should be labeled with name and quantity (actual amount or %) of the item. Also remind students that the sum of the percentages may not total 100% due to rounding. However, if their total is off by more than 1% or 2%, they should double check their computations!

Suggested Assignment: Page 39, #1-3

QUIZ 3 Anytime after Lesson 12

Lesson 13: Bar Graphs and Pictographs

Vocabulary: bar graph, pictograph

Comments: Read pages 33-35 in class.

«GENERALIZE RESULTS» Ask the students to describe the differences between histograms and bar graphs. They should note that graphs can be used for either continuous (Example 3) or discrete (Example 4) variables.

Note that in exercise 7 on page 41 the percent of lead recycled has been omitted. By studying the pictograph they should come to the conclusion that between 40% and 48% of the lead is recycled. They should estimate the amount for their bar graph.

Suggested Assignment: Page 41, #7-13

Lesson 14: Frequency Polygons, Normal Curves

Vocabulary: frequency polygon, line graph, normal curves, normal distributions

Comments: Read pages 36-39 with the class. Another name for frequency polygon with which they are probably familiar is line graph.

«USE RESOURCES» Ask the students to analyze Figures 2.6 and 2.7 on page 38. Who would be interested in using Figure 2.7? Have the students bring in other examples of misleading graphs from newspapers and magazines.

Students should note that the class mark can be used on the horizontal axis instead of the interval. Points are plotted above the class mark and beside the frequency.

When discussing normal distributions ask the students to suggest other distributions which graph as normal curves. You might want to do part of exercise 14 (page 44) orally in class.

« CLARIFY VOCABULARY »

Students may need to review vocabulary and definitions from the beginning of the chapter before they complete Worksheet 3. Encourage them to use their text and earlier worksheets for this review. The students should not be dependent upon others for this information.

Suggested Assignment: Page 40, #6

Page 44, #14

Worksheet 6

Lesson 15: Frequency Polygons and Normal Curves (continued)

Comments: This period should be used as a question-answer session and as a work period.

Suggested Assignment: Worksheet 7

Lesson 16: Ogives

Vocabulary: cumulative % graph, ogive

Comments: Explain that on a cumulative % graph the horizontal axis represents values of the variable and the vertical axis represents cumulative percent. When data have been grouped, each point on the graph is plotted over the upper class boundary of the interval. Each point represents the percent of observations falling at or below that value. The line connecting these points is referred to as an ogive.

The transparency provided can be used to complete the construction of an ogive for the exercise on Worksheet 5.

« DETERMINE NATURE OF ANSWER »

The ogive starts at 0% and ends at 100%. Why?

The teacher may choose to assign Worksheet 7 over a two-day period depending upon the class.

Suggested Assignment: Worksheet 8

Lesson 17: Review

Comments: This period should be used as a question-answer session and as a work period.

Suggested Assignment: Pages 45-46, Master Test Form A

Pages 47-49, Master Test Form B, exercises 1, 4, 5

Lesson 18: Graphing Project

Comments: This is a review project which should help students to pull together a lot of the concepts from this chapter. The students should work on the project both at home and in class where they can they can ask questions. Students may find it easier to work together while compiling data and making frequency distributions. However, each student should turn in his or her own project at the designated time. Allow at least two class periods for this work. The completed projects can be graded and treated as either a quiz or a test.

≪ORGANIZE APPROACH≫

Suggested Assignment: Worksheet 9 (Graphing Project)

Lesson 19: Graphing Project (continued)

Comments: Offer constructive criticism to students as they continue to work on graphing project.

Lesson 20: CHAPTER TEST

CHAPTER 3 AND CHAPTER 4

Comments: Chapter 3, "Numerical Methods for Analyzing Data", and Chapter 4, "Percentiles and Z-Scores" will be taught in a slightly different order than that recommended by the author. The lessons in this section will begin with a study of percentile and percentile rank. This will be followed by the first two sections of Chapter 3: Measures of Central Tendency and Measures of Variation. Before concluding Chapter 3, Z-Scores will be studied.

Read T-5 and T-6 in the Solutions Manual and pages 28-46 in the Department of Education's Statistics Curriculum Guide.

Lesson 1: Percent and Rank

Vocabulary: percent, rank

Comments: Begin the period by having the students spend 10-15 minutes completing Worksheet 1. The worksheet is designed to make them think about comparisons. When discussing percent, we are generally comparing the number correct to the total possible, the number absent to the total number, and so on. Discuss each of the problems on the worksheet and be sure that students understand what is being compared. If someone is trying to

≪STATE CONDITIONS OF THE PROBLEM≫

≪CLARIFY MEANING≫

identify the top 10% of the scores on a test, he or she is not trying to find people who scored 90% or better. The answer to this problem has nothing to do with the actual scores people received. It has to do with the highest scores, even if everyone failed. To identify the top x%, it is necessary to rank the scores.

Suggested Assignment: Worksheet 1 (to be done at the beginning of class)

Lesson 2: Percentile and Percentile Rank

Vocabulary: percentile, percentile rank

Comments: Use Transparency A to introduce the concepts of percentile and percentile rank. The percentile rank tells the percent of persons in a group that are below a certain score, position, or rating. It gives the rank of a person in percent form. After discussing the transparency itself ask additional questions such as:

- What is PR_{700} ?
- What percentage of people scored above 400?
- What does a percentile of 88 mean?
- What percentage of people scored between 300 and 400?
- Is the 25th percentile of the scores closest to 275, 300, or 350 ?

≪ESTIMATE≫

Ask students which graph they have studied could be used to approximate percentiles (Ogive). Transparency B, a transparency of an ogive, is provided for the Chapter 2 Graphing Project, Data Number 2. Students should realize that information on this graph will allow them to estimate percentile ranks of different values, but exact percentile ranks cannot be computed. Why? Ask students questions concerning the ogive such as:

- What is the approximate PR_{120}?
  (What percent of scores are below 120?)
- Find the approximate value of P_{25}.
- At this university students with less than 50 credits are freshmen. 50-99 = sophomores, 100-149 = juniors, and 150-199 = seniors. Two hundred credits are needed to graduate. What percent of students surveyed were juniors? Were more freshmen or sophomores surveyed?
- What percent of students have earned between 50 and 85 credits?

«OUTLINE PROCESS» Before assigning Worksheet 2 have the class read and discuss the method for approximating percentile ranks. (It is explained after Exercise 4 on the worksheet.) Be sure that students understand how the proportion is determined and, once a value for x is known, how the final answer is found.

Suggested Assignment: Worksheet 2

Lesson 3: Percentile and Percentile Rank (continued)

Vocabulary: lower quartile, upper quartile

Comments: This lesson deals with pages 84-87 of the text. Read and discuss the material on page 84 and Example 1 on page 85. Ask the students why it is necessary to consider the number of terms equal to the given score in a problem. (This is E in the book's formula.)

«DEFINE TEPMS» Explain to the students that any table that lists scores and their corresponding percentile rank always stops at the 99th percentile, e.g., college board scores. Can they explain why? They should understand that P_{100} does not exist. It is impossible for someone to have a score better than 100% of all scores. (How can your score be better than itself?)

Have the students read and discuss the definitions of lower quartile and upper quartile on page 87.

When doing exercise 3 on page 92, students may assume that every score in the given interval is equal. Another way to think of this is to say that half the terms in the interval are lower in value than the given score and half the terms are higher in value. Since exact information on scores in interval form is not given, one of these two ideas must be used.

Suggested Assignments:: Read pages 84-87

Pages 91-92 #1-4

QUIZ ! Anytime after Lesson 3

Lesson 4: Measures of Central Tendency

Vocabulary: measures of central tendency, mean, median, mode, average, summation notation, Σ (sigma), $\bar{x}$, μ

Comments: Most students have used or discussed averages in their day-to-day lives. Batting averages, the "average" family, and "average" height are only a few of the common uses. However, few students are aware that there is more than one type of average. Marketing representatives and advertisements generally use the average that best suits their needs.

« CLARIFY MEANING » Explain that a measure of central tendency is a single number which characterizes the data set. Read and discuss page 54, 55, and the first two paragraphs on page 56 with the students. Note that in this text the word average is synonomous with the mean average. In general, though, average can refer to mean, median, or mode.

« SUITABLE NOTATION » Introduce the summation notation sigma, Σ, and the symbols for the sample mean, $\bar{x}$, and the population mean, μ, as a shorthand. Be sure to explain the formula for the mean using this notation.

Use Transparency A to find the mean, median, and mode for points received in a cribbage game. Cover the bottom half of the sheet while the students do the original computations. Use Transparency B to consider questions such as:

> What happens if the largest score (15) is replaced by the score 24? How does this affect the mean? median? mode?
>
> How are the mean, median, and mode affected if the score 5 is replaced by the score 3?

Suggested Assignment: Read pages 55-59
Pages 64-65 #1-3

Lesson 5: Measures of Central Tendency (continued)

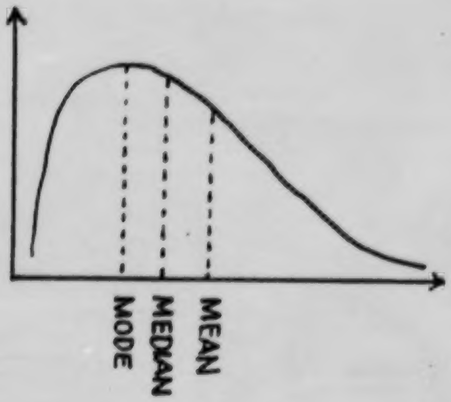
Comments: Begin by reviewing the properties of mean, median, and mode. A transparency is provided for this purpose.

The remainder of this period should be used as a question-answer session and as a work period. Students should be encouraged to work together when necessary. The problems in Worksheet 1 require that the students understand the concepts of mean, median, and mode.

Suggested Assignment: Page 65 #4-5
Worksheet 3

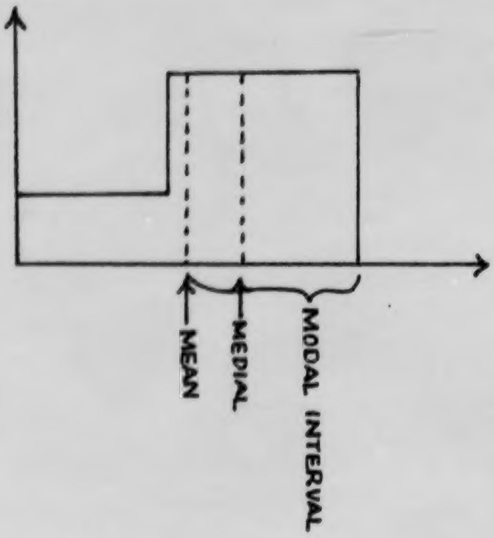
Comments: Begin by discussing Worksheet 6, especially problems 5-7, students should be aware of how a constant change affects the mean, median, and mode of a distribution. (They all increase or decrease by the same amount.)

«ESTIMATE» Explain that measures of central tendency can be estimated from graphical distributions. Use Transparency A to demonstrate this. Explain that this is a frequency polygon, or line graph, with the lines smoothed into a curve. The mode is the easiest value to identify. It is the score with the largest frequency; therefore, it is the score directly below the highest point on the graph. The median of a distribution divides the graph into two equal areas. The mean average is not as easy to estimate. The estimate depends on the shape of the distribution. In this case, the data includes extreme, large scores. These scores affect the value of the mean more than any other measure of central tendency. It will have a larger value than either the mode or the median.



«CLARIFY MEANING» Estimating the mean, median, and mode this way is difficult for some students. One mistake commonly made is to identify the mode as the largest frequency rather than the term with the largest frequency. If students continue to have difficulty the teacher may want to label the axes of line graph with specific scores and frequencies and then create a frequency distribution from the data. Students can then compute the mean, median, and mode and compare these answers to the estimated ones.

Have the students estimate the mean, median, and mode for the graph on Transparency B before any discussion is held. In this case, there is more than one mode; there is a modal interval. Also, the presence of a small number of small terms gives the mean a lower value than the other measures.



Suggested
Assignment: Worksheet 4

QUIZ 2 Anytime after Lesson 6

Lesson 7: Measures of Central Tendency for Grouped Data

Comments: In class examine the frequency distribution on page 60 and analyze formula 3.2. Compare this formula to formula 3.1. Students need to understand how the formulas are related. Transparency A assists in the explanation and Transparency B provides another problem for the students to do.

Example 4 on page 60 extends the formula for use with grouped data in interval format. The students should notice two things in this example.

1) The class mark is used to estimate the value of x.

«CHECK EACH STEP»

2) Because the author let the largest value in one interval equal the smallest value in the next interval, a note of explanation had to be included so that the table can be interpreted correctly.

Suggested
Assignment: Read Example 5, pages 61-62
Page 65-66 #6-8 and 10-12

Lesson 8: Measures of Central Tendency for Grouped Data (continued)

Comments: Use the transparency provided to review finding the mean of grouped data in interval form. Ask the students what columns need to be added to the table.

Have the students identify the modal interval. Remind the students that the modal interval is the interval with the highest frequency, not the value of the frequency itself. Therefore, the modal interval is 15 - 19.

Explain that the term median interval refers to the interval containing the median score. (It does not refer to the middle interval.) Using the same transparency as before ask the students what the total number of sales were at Eastern Electric. Since there were 29 sales the sales would be the 15th one.

The number of sales are already ranked in the table, so to find number 15, count down in the frequency column. The fifteenth sale is in the interval 15 - 19. Therefore, the median number of sales is between 15 - 19. Some students will have difficulty with this concept. It may help to "list" the scores, reminding students how to interpret the table:

≪ORGANIZE A LIST≫

1st person's sales : 0 - 4 } f = 2
2nd " " : 0 - 4
3rd " " : 5 - 9 } f = 4
4th " " : 5 - 9
5th " " : 5 - 9
6th " " : 5 - 9
7th " " : 10 - 14
etc.

≪EXTEND THE PROBLEM≫

In addition to finding the median interval, it is possible to estimate the median itself. See page 36, problem 5c of the State Statistics Course Curriculum Guide for a description of the method used. Interested students and the better students should be encouraged to use this method.

Suggested Assignment: Worksheet 5

Lesson 9: Weighted Means

Vocabulary: weighted mean

Comments: Read and discuss formula 3.3, example 6 and example 7 on pages 62-64. Ask students to identify other uses of weighted means.

The rest of this period should be used as a question-answer session and as a work period. Questions 5, 6, and 7 are intended to help the student realize that the sum of the deviations of each value in a set from the mean is always zero. Be sure to discuss why this is true.

Suggested
Assignment: Worksheet 6

QUIZ 3 Anytime after Lesson 9

Lesson 10: Absolute Value

Vocabulary: absolute value, $| \; |$

Comments: Any study of the measures of variation (or dispersion) in statistics requires the ability to do computations involving absolute value. The only prerequisite to this course is Core Algebra, and work with absolute value is not a required objective of that course. Therefore, both the concept of and the symbol for absolute value should be explained in class. Emphasize that absolute value is concerned with distance. The teacher may find that students need to review adding and subtracting signed numbers. Be sure to discuss examples such as:

« INTRODUCE SUITABLE NOTATION »

$|{}^{-}7| =$

$3 \cdot |2| =$

$|4 + ({}^{-}1)| =$

$|x| = 4; \; x =$

$|4| + |{}^{-}1| =$

$|x + 1| = 6; \; x =$

$- |{}^{-}2| =$

$|x| + 1 = 6; \; x =$

Suggested
Assignment: Worksheet 7

Lesson 11: Measures of Variation

Vocabulary: measures of variation, range, measures of dispersion, average deviation

Comments: Section 3.2 covers a lot of material very quickly without much explanation.

The description of range is fairly straightforward. Read page 67 with the students (or have them read it in advance). Ask them to identify other items for which the range is specified.

« MAKE DECISION »

Ask the students to decide which expressway George should use to get to school. (See Transparency A.) In both cases the average (mean) time is 20 minutes. Some students may notice that the distribution for Kalakaua Expressway is "narrower." It has a smaller spread.

Tell students that range is not always a good indicator of spread or dispersion as seen in the transparency example. Can they suggest alternate ways to measure the spread?

CLARIFY MEANING OF TERMS

If necessary prompt the students to discuss the "average distance from the mean." See Transparency B. Students should remember that the sum of the distances of the scores from the mean is zero. Therefore, the average is zero! Someone will probably (hopefully?) suggest that you measure how far each score is from the mean--not whether it's positive or negative. Then the spread can be measured by finding how far, on the average, the scores are from the mean. Show this by using the transparency overlay provided. This is called the average deviation. Have students find the average deviation for the time spent on Cooke Expressway.

Suggested Assignment: Page 75 #1-2
#3-5 (Find range and average deviation only!)

Lesson 12: Σ, the Summation Notation

INTRODUCE SUITABLE NOTATION

Comments: The summation notation, Σ, is used frequently throughout the study of statistics. Students have already encountered one use of Σ when finding means. Students need practice with problems involving Σ. Students often have difficulty reading the problems and deciding what the order of operations should be. Before assigning Worksheet 8 discuss examples such as:

Given: $x = \{3, 1, 2, 2\}$ Find

Σx	$\Sigma(x - \mu)$
Σx^2	$\Sigma(x - \mu)^2$
$\Sigma x + 1$	$\Sigma\|x - 3\|$
$\Sigma(x + 1)$	$\Sigma 3x$

Suggested Assignment: Worksheet 8

Lesson 13: Measures of Variation (continued)

Vocabulary: variance, σ^2, s^2

Comments: Tell the students that measures of variation are used to picture a distribution without actually showing the whole distribution. For example, the mean score on a recent test was 34 (out of 40) and the range was 21. The average deviation was 3. Without knowing all the scores the student should picture at least one "outlier" causing the range to be that large.

Each measure of variation is a unique number and is often dealt with algebraically. Because of the absolute value signs the average deviation is difficult to use this way. Other measures of variations are more useful. Ask the students if they can think of any other ways to measure dispersion.

OUTLINE STEPS USED TO SOLVE PROBLEM

One problem encountered was that $\Sigma(x - \mu) = 0$. The use of absolute value eliminated that problem and resulted in the average deviation. If each difference is squared before the sum is taken the problem of a zero sum is eliminated again. $\Sigma(x - \mu)^2 \neq 0$ unless every $x = \mu$. The variance is defined using this expression:

$$\text{variance} = \sigma^2 = \frac{\Sigma(x - \mu)^2}{n}$$

σ^2 (sigma squared) is the symbol for the population variance. s^2 (s squared) is the symbol for the sample variance. The variance is actually the average of the sum of the squared distances from the mean. Use Transparency B from Lesson 11 (on Kalakaua Expressway) and the overlay provided for this lesson to demonstrate computation of the variance. (The computational form of the variance will be introduced later in section 3.3.)

Suggested Assignment: Page 75 #3-5 (Find the variance!)

QUIZ 4 Anytime after Lesson 13 (The teacher may want to provide the formulas for average deviation and variance.)

Lesson 14: Square Roots

Vocabulary: square root, $\sqrt{\ }$

« STUDY TABLES »

Comments: Any course of study in statistics requires the ability to do computations involving square roots. The only prerequisite to this course is Core Algebra and work with square root is not a required objective for that course. Therefore, both the concept of and the symbol for square root should be discussed in class. Students do not need to know how to compute square roots, but they do need to understand what square roots are and how to find a decimal approximation using Table 1 on page 454. Some students may have calculators with a square root function, however, they should also understand how to use the table. Using the table, discuss examples such as:

$\sqrt{16}$ $\quad$ $\sqrt{29}$

$\sqrt{5}$ $\quad$ $\sqrt{276}$

$\sqrt{1.3}$ $\quad$ 3.42^2

Suggested Assignment: Worksheet 9

Lesson 15: Measures of Variation (continued)

Vocabulary: standard deviation, σ (sigma), s

Comments: Pages 68-70 can be used to introduce standard deviation as another measure of variation.

Use Transparency B from Lesson 11 (on Kalakaua Expressway) and the overlay provided for this lesson to demonstrate computation of the standard deviation. Explain the use of the approximation symbol ($\approx$).

« CLARIFY NOTATION »

Be sure to discuss the notation used for standard deviation (σ) and to differentiate between population standard deviation (σ) and sample standard deviation (s). Ask the students to explain the relationship between the symbols used for variance (σ^2) and standard deviation (σ).

Suggested Assignments: Read pages 68-71
Page 75-76, #3-5 and #7 (Find the standard deviation!)
(For exercises 3-5, the variance was computed in Lesson 13 so finding the standard deviation should be straightforward. For exercise 7 the students must do the computations from scratch.)

Lesson 16: Measures of Variation (continued)

Comments: Have the students read §3.3 (pages 71-73). They should note the advantage of this computational formula: the mean value does not have to be known. Use the transparency provided to demonstrate use of the computational formula.

APPLY ANOTHER TECHNIQUE TO SOLVE THE SAME PROBLEM

Students have already computed variance for exercise 7, page 76 as part of Lesson 15's Suggested Assignment. Have them compute variance using the computational formula. Discuss which computation was easier and why.

The rest of the period should be used as a question-answer session and as a work period.

Suggested Assignment: Pages 75-76, #6 and #8

QUIZ 5

Anytime after Lesson 16

Lesson 17: z-scores

Vocabulary: z-score

Comments: Present the following situation to the class:

> Mr. Lani gave the same test to two of his classes. Joanne, from his first period class, had a raw score of 56. In his second period Keala's score was also 56.

DETERMINE WHETHER DATA IS SUFFICIENT

LIST ALL INFORMATION GIVEN AND RELATED FACTS

Ask the class if Joanne and Keala did equally well when compared to their classmates. They should realize that more information is needed. Tell the class that Joanne and Keala had percentile ranks of 82.5 in their respective classes. Can they answer the question now? Tell the class that both students consistently score in the 50's on this kind of test. If another test is given what percentile rank would the class expect Joanne and Keala to score? The class will probably guess somewhere around 82.5. Show them Transparency A and ask them to reconsider the question. The class should realize that Joanne's score is far superior to most of her classmates' scores. In another test she would probably continue to be a superior student and maintain the high percentile rank. However, in Keala's case, a score in the low 50's could change his percentile rank dramatically. He is not necessarily a better student than his classmates. They appear to be fairly evenly matched. Explain that for this reason percentile ranks often leave questions unanswered and another way of describing the position of a term is necessary.

Explain that this new method involves measuring the distance and the direction of a score from the mean. Another set of data is used on Transparency B to show the distance measurement. After discussing the transparency explain that the distance measurement by itself is still not a satisfactory way to compare two scores. Show Transparency A again. The best score in Keala's class is less than 6 points (58 - 52.55 = 5.45) from the mean. Does that make it comparable to the score of 40 in Joanne's class which is almost 6 points from the mean (40 - 33.9 = 6.1)? No!

Before scores from different classes can be compared they must be compared to scores within their own class. Comparing them by means of a percentile rank didn't work for this purpose. However, using the standard deviation as a "ruler" will.

«IDENTIFY KEY ELEMENTS»

Use Transparency C to demonstrate how to use this "ruler" (cover the bottom half while discussing the top portion). Students should discover that the entire process results in measuring the number of standard deviations a score is from the mean. The number of standard deviations is called the z-score. Have the students determine the formula for finding z-scores (without referring to their books!). Finally, use Transparency D to compare Joanne's and Keala's scores again.

Suggested Assignment: Worksheet 10

Lesson 18: z-scores (continued)

Comments: Have the students read and discuss pages 88-91. Be sure that students understand why the sum of the z-scores in a distribution will always equal zero.

«EXPLAIN PROCESS»

Compare the formula for calculating the z-score and the formula for calculating the original score. Be sure that students understand that one formula is derived from the other. Demonstrate that either formula can be used to calculate the z-score, mean, or original score given the other two values. However, the different forms are used to make the computations easier.

The rest of the period should be used as a question-answer session and as a work period.

Suggested Assignments:
Page 93-94, #6-11
Page 95, Mastery Test, Form A

Lesson 19: z-scores (continued)

Comments: Review the meaning of normal distribution with the class by asking questions such as:

« CLARIFY DEFINITION »

- What is a normal distribution?

« DRAW A DIAGRAM »

- What does a normal distribution look like?
- What is a skewed distribution?
- Name some data sets that would be approximately normally distributed.

Explain that in a normal distribution the percentile rank can be approximated if the z-score of a value is known and vice-versa. A transparency of the diagram in exercise 6, page 96 is provided for discussion. Show the transparency so that only the diagram and z-scores are showing. (Cover the lower portion.) Explain that the percentages shown are rounded. Ask the students to interpret the diagram by asking questions such as:

« ANALYZE AND INTERPRET DIAGRAM »

- What does the 14% represent? (Point to the section between $z = -2$ and $z = -1$.)
- What percent of scores fall between $z = 0$ and $z = {}^{+}2$ in a normal distribution?
- What percent of scores have $z < -1$?
- What percent of scores are below $z = 0$? (Does this make sense?)
- 16% of the scores are above what z-score?

Reveal the scale for the Educational Testing Service.

- What is the mean ETS score?
- The ETS has a standard deviation of what amount?
- What is the z-score for an ETS score of 600?
- Someone who scored 600 on the ETS exam did better than what percent of the people?

Reveal the remainder of the transparency and ask similar questions. Be sure to ask for comparisons such as:

- Who did better relative to other people in their group: someone with an ETS score of 400 or someone with a WISC score of 95?
- Two people took the same test. One had a percentile rank of 75. The other had a z-score of 1.2. Who did better?

001 38

Suggested Assignment: Page 96, #6
Worksheet 11

QUIZ 6 Anytime after Lesson 19

Lesson 20: Coding

Vocabulary: coding

Comments: Worksheet 3 for this chapter included two problems (#5, #6) in which the same number was added to or subtracted from each term in the distribution. Ask students to recall what happened to the mean of the distribution.

List the set C = {27, 35, 19, 23, 34, 18} on the blackboard. Define a new set D by subtracting 25 from each element of set C. Have the class predict the relationship between the means of these two sets before asking them to do the actual computation.

«GUESS AND CHECK»

Use the top half of the transparency provided to review the computational formula while calculating variance and standard deviation for set C. Have the students predict the variance and standard deviation of set D based on these results. After computing these values have the sudents explain why σ^2 and σ are the same in both sets. If necessary remind them that subtracting a constant amount from each term "slides" the distribution sideways on the horizontal scale. It does not affect the shape of the distribution, just the location. Since the mean deals with location the value changes. The variance and standard deviation are concerned with the spread or shape of the distribution and are therefore not affected.

Suggested Assignment: Read pages 73-75
Page 76, # 9-11
Pages 78-79, Mastery Test, Form A

Lesson 21: Review Project

Comments: This is a review project which should help students to pull together a lot of the concepts from this chapter. The students should work on the project both at home and in class where they can ask questions. Students should be encouraged to work in pairs for ease in compiling data and making frequency distributions. Groups of 3 or more tend to get out of hand. Allow at least three class periods for this work. The completed projects can be graded and treated as either a quiz or test.

《APPLY PROCESSES TO SIMILAR PROBLEMS》

Suggested Assignment: Worksheet 12

Lesson 22: Review Project (continued)

Comments: Offer constructive criticism to students as they continue to work on project. Remind them that work should also be done at home between classes.

Lesson 23: Review Project (continued)

Comments: See comments for Lesson 22.

Lesson 24: CHAPTERS 3 & 4 TEST

The Chapter Test consists of Parts I and II. Depending on the length of the period these may be, given on the same day or on separate days. Also, Part II requires the use of many different formulas. The teacher may allow the students to use their books, a "crib sheet," their notebooks or nothing at all in doing this section. If both Parts are given on the same day be sure to collect Part I before allowing the use of books, notes, and so on for Part II.

CHAPTER 9

Comments: Read T-11 in the Solutions Manual and pages 47-59 in the Department of Education's Statistics Curriculum Guide.

Lesson 1: Introduction to Correlation

Vocabulary: variable, correlation, positive correlation, negative correlation, zero correlation, cause-and-effect relationship

Comments: Have the students study the data on live births and marriages in the U.S. (page 252). Ask them to describe the data to you. If they have difficulty prompt them with questions such as:

« STUDY AND ANALYZE TABLES »

- For what years is data provided?
- How many births occurred in 1966? How many marriages?
- Does the number of births steadily increase over time?
- What is the trend in number of marriages?
- Is there any relationship between number of births and number of marriages?

Read and discuss page 252 and the table on page 252. One relationship students should discover is that the percent of males plus the percent of females for a given occupation in a given year equals 100%. Thus, if the percent of males decreases the percent of females increases.

«GENERALIZE»

Ask the students to analyze the relationship between the amount of money deposited in a savings account and the amount of interest earned. Someone should notice that the amount of interest increases as the amount of the deposit increases. Ask the students what relationship exists between the height of people and their shoe size. Although it is not *always* true, the general relationship is one in which the taller the person, the larger the shoe size. Again, ask the students to analyze what happens to the number of houses purchased when the availability of mortgage money decreases. (Generally, as availability of money decreases the number of houses purchased also decreases.)

«CLARIFY MEANING OF TERMS»

Explain that the three examples given above are examples of positive correlation. The two variables are directly related. That is, when one variable increases (decreases) the second variable also increases (decreases). Ask the students to think of other examples of positive correlation.

Define negative correlation and ask the students to describe examples. (A negative correlation indicates that there is an inverse relationship between two variables. That is, as one increases the other decreases.) There are many examples related to trends in purchasing. As the cost of an item increases, the number of purchases goes down.

Explain that two variables do not always have to be related. When this happens the variables are said to have zero correlation. For example, there is zero correlation between someone's height and bowling average.

Suggested Assignment: Page 264, #2
Worksheet 1

Lesson 2: Scatter Diagrams

Vocabulary: scatter diagram, linear correlation

Comments: Explain that lists of pairs of variables are often hard to absorb. However, if they are presented graphically the relationship between the variables can be seen more readily. A graph used to analyze the relationship between two variables is called a scatter diagram.

«ORGANIZE DATA IN A GRAPH»

Use the transparency provided to demonstrate the construction of a scatter diagram. Be sure to discuss the selection of an appropriate scale for both axes. Also, make sure that students understand that the dotted lines used on the transparency are for illustration purposes only. They should not be drawn or included on other graphs. The teacher or students should graph the remaining points without using these "aids." Ask the students whether the scatter diagram indicates a positive, negative, or zero correlation between the two variables.

In some cases a straight line can be drawn to approximate the dots on a scatter diagram. This is true in the example above. Demonstrate this linear correlation by sketching the line on the transparency.

《 CAN INFORMATION BE USED FOR FORECASTING 》

Ask the students why a line such as the one just drawn would be of interest to anyone. Someone should realize that this line helps people to predict one variable's value if the second value is known.

Discuss the scatter diagrams shown on page 260.

Note: To show multiple points at one location on the scatter diagram the number of points can be written and circled next to the appropriate dot. E.g., • ③ indicates 3 pairs of data are represented by the dot.

Suggested Assignment: Read pages 256-258
Pages 264-265, #1, 4, 5, 10, 11 (Draw scatter diagrams only!)

Lesson 3: Correlation Coefficient

Vocabulary: coefficient of linear correlation

Comments: Have the students look again at Figure 9.6 on page 260. Ask them why they think two sets of data are highly correlated and two of them are not. The highly correlated sets indicate a tighter clustering; that is, the sets have a stronger correlation.

Ask the students for suggestions on how to summarize a scatter diagram numerically. Suggestions might include identifying the range of both variables, the center of the distribution (the point with coordinates equal to the mean of each variable), and the standard deviation for each variable. See Transparency A.

《 CLARIFY VOCABULARY 》

Show students Transparency B. These distributions have the same center, the same ranges, and the same standard deviations. However, scatter diagram (a) is more highly correlated than diagram (b). More information is needed to indicate this. This summary statistic is called the correlation coefficient.

Explain that the coefficient of correlation for any set of paired observations will be between ± 1. A coefficient of 0 means there is no correlation between the two variables. A coefficient of $^+1$ or $^-1$ means there is a perfect linear correlation. Ask the students if they can guess what the difference is between coefficients of $^{+}1$ and $^{-}1$. Explain that the closer the correlation is to $^{+}1$ or $^{-}1$ the "tighter" the correlation is between the two variables. Use Transparency C to show some examples. Ask the students to identify paired observations that these scatter diagrams could represent. (E.g., $r = {}^{+}1$ when comparing speed of travel and travel time and maybe $r = {}^{-}.50$ when comparing the age of a used car and its price.)

《LIST RELATED FACTS》

Note: Problems 12-19 on Worksheet 2 review summation notation. In the next lesson these figures will be used to determine the correlation coefficient for the given set of data. Before assigning this worksheet be sure that students know how to complete the y-column in exercise 12.

Suggested Assignment: Pages 264-265, #1, 4, 5, 10, 11 (Guesstimate the correlation coefficient using scatter diagrams drawn for the last assignment.)
Worksheet 2

Lesson 4: The Coefficient of Correlation (continued)

Comments: Explain to the students that there is a formula for computing the value of the correlation coefficient. Show the formula on Transparency A. Discuss the pieces of the formula and their interpretation. Be sure that students understand how to find each piece individually given a set of paired observations.

《IS ANSWER REASONABLE》

《DETERMINE NATURE OF ANSWER》

Have students look at Exercises 12-19 on Worksheet 2. How can that information be used to find the correlation coefficient for the set of paired observations? Do the calculation on Transparency B by completing the substitution of the appropriate values into the formula. A review of the order of operations may be necessary! Ask the students what the final result ($r = +.562$) means. Does that make sense? As one value increases, in general general, does the other variable also increase? Ask the students what would have been indicated if they computed $r = +1.6$. Point out that verifying $^{-}1 \leq r \leq {}^{+}1$ is a good first check.

Show Transparency C and give the students a few minutes to do the computation. Have someone talk through the problem explaining how they arrived at the final answer ($r = {}^{-}.39$).

CALCULATORS!

Note: Computing the coefficient of linear correlation requires the students to make use of many algebraic concepts learned. They must add, subtract, multiply, and divide signed numbers, square numbers, take square roots, and use the order of operations. The computations can be unwieldy and the use of a calculator is almost mandatory. Review with the students how to use a calculator efficiently. If their calculators have a memory show them how to use it effectively. If there are no parentheses what steps can be followed to reduce the number of keystrokes when solving a problem? Most calculators have features that would make these computations easier, but the students are not aware of them. You may want to take one period to review these features depending upon your class make-up.

Suggested Assignment: Worksheet 3

Lesson 5: The Coefficient of Linear Correlation (continued)

Comments: This period should be used as a question-answer session and as a work period.

Suggested Assignment: Read pages 259-261
Page 265-267, #4, 5, 10, 11 (Complete the problems started earlier.)
Page 265, #6

Lesson 6: Coefficient of Linear Correlation (continued)

Comments: Have the students read and discuss Example 2 and Example 3 on pages 261-263. Be sure students are aware that coding data does not affect the value of r for a set of data.

The remainder of this period should be used as a question-answer session and as a work period.

Suggested Assignment: Pages 265-266, #7, 8, 9

QUIZ I Anytime after Lesson 6

Lesson 7: Linear Regression

Vocabulary: estimated regression line, linear regression, dependent variable, independent variable, linear equation

Comments: Show Transparency A to the students and ask them to describe the graph. What information can be obtained from the graph? Have students make up questions from the graph which other students can then answer.

« ANALYZE AND INTERPRET GRAPH »

Although students have dealt with linear relations in Core Algebra they will probably need a short review. Review the vocabulary words linear equation, independent variable (x), and dependent variable (y).

Next show Transparency B. Ask students what type of relationship appears to exist. Is there a positive, negative, or zero correlation

Is the relation linear? Explain that even though the relationship is not perfectly linear a line can be drawn to approximate the data. The line represents or estimates the relationship between the two variables. Place the overlay on Transparency B. A line has been "fitted" to the data. It is called the estimated regression line and can be used to predict one variable's value when the other one is known. Ask the students to predict different outcomes using the estimated regression line. (E.g., If $11,500,000 worth of property is stolen in Honolulu County in 1984 predict the value of property recovered.)

EXPLAIN
HOW AND
WHY THE
APPROACH
WORKED

Next show Transparency C. Draw a straight line on a clear piece of acetate. Have a student come up to the overhead projector and place the acetate on Transparency C so that this line "best fits" the data. Let other students vary the position of the line if they feel it should be altered. Ask the students what criterion they think should be used in piecing the estimated regression line on the graph. Once a line has been agreed upon, use it to predict someone's business score if the math score is known. How reliable is this prediction? How much would the students expect their predictions to vary from actual outcome?

Suggested
Assignment: Read pages 269-271
Worksheet 4

Lesson 8: Linear Regression (continued)

Comments: This period should be used as a question-answer session and as a work period. However, problems assigned from the book should be given special instructions. Any time the exercise asks for the least squares prediction equation students should instead draw a scatter diagram and the estimated regression line. Depending upon the ability and background of your students the equation itself can be estimated.

Suggested
Assignment: Pages 276-278, #1, 2, 5, 6, 8 (see comments for instructions)

Lesson 9: Linear Regression (continued)

Vocabulary: method of least squares

Comments: Ask the students how many estimated regression lines each set of data can have. Is there always going to be a "best-fit" or is there really quite a bit of leeway in selecting the line? Explain that there is exactly one "best-fit" and that it is found using something called the least squares method.

« READ THE PROBLEM ALOUD »

Discuss the first paragraph of section 9.5 on page 272. Figure 9.12 helps to illustrate the concept of least squares. Students will not be asked to derive the equation for any estimated regression lines. Instead they will be given the equation and asked to plot the line and/or to use it to make predictions.

Note: Some teachers may wish to have some or all of their students work with the formula itself to determine the estimated regression line equation for specific sets of data.

Show Transparency A to the class. Ask students what the equation means and how it could be used. Draw a sketch of the regression line. (This is a good time to review graphing!) Ask the students how they think the equation can be interpreted. What does it tell us if the objects in Mary's trunk weigh 70 pounds? Emphasize that this equation is the best fit--the line for which the sum of the squared deviations is as small as possible.

Show Transparency B and ask questions similar to those asked for Transparency A. Be sure to ask students what the limitations of this equation is ($0 \le$ G.P.A. ≤ 4.0).

Suggested Assignment: Worksheet 5
Pages 284-285, Mastery Test A, #1-5, 9, 10

Lesson 10: Review

Comments: This period should be used as a question-answer session and as a work period. Note that students should not compute least squares prediction equations when asked to do so in the problems (unless you have covered this in class). Instead they should complete the scatter diagram and sketch the line. They can then use the line to predict values for the dependent variable, given values for the independent variable.

RULERS!

Note: To avoid confusion in the collection of data for the second assignment have all students start work on Mastery Test B. Have students come to the front of the room one at a time to write their height and foot length on the blackboard. Be sure to have rulers available for students to measure their foot length (and height, if necessary).

Suggested Assignment: Pages 285-287, Mastery Test B
Collect and analyze the data comparing foot length and height of members of the class--predict parent's and friend's foot length using these results.

Lesson 11: CHAPTER TEST

Final Project

Comments: This final project is intended as a review for some of the year's major topics. Before assigning the project, however, discuss the things that students should consider when writing survey questions. Some of these considerations are outlined on the transparency provided. Also discuss the types of questions that can be asked (also outlined on the transparency). Answers to certain types of questions are easier to tally and analyze than others are. Be sure that students understand what they are to do for this final project. Go over the directions with them.

Having each student design a survey and then collect and analyze data is the preferred way of doing this project. However, if this proves to be impossible for reasons of time and/or logistics the class can design and administer one survey. Students can then be assigned to study and report on one aspect of the survey, or if possible, each student can complete an individual report on all aspects of the data.

Suggested Assignment: Final Project Worksheet

FINAL EXAM

MASTERS FOR WORKSHEETS, TRANSPARENCIES, QUIZZES, AND TESTS

Statistics Course Introduction
Worksheet 1

Name

Date

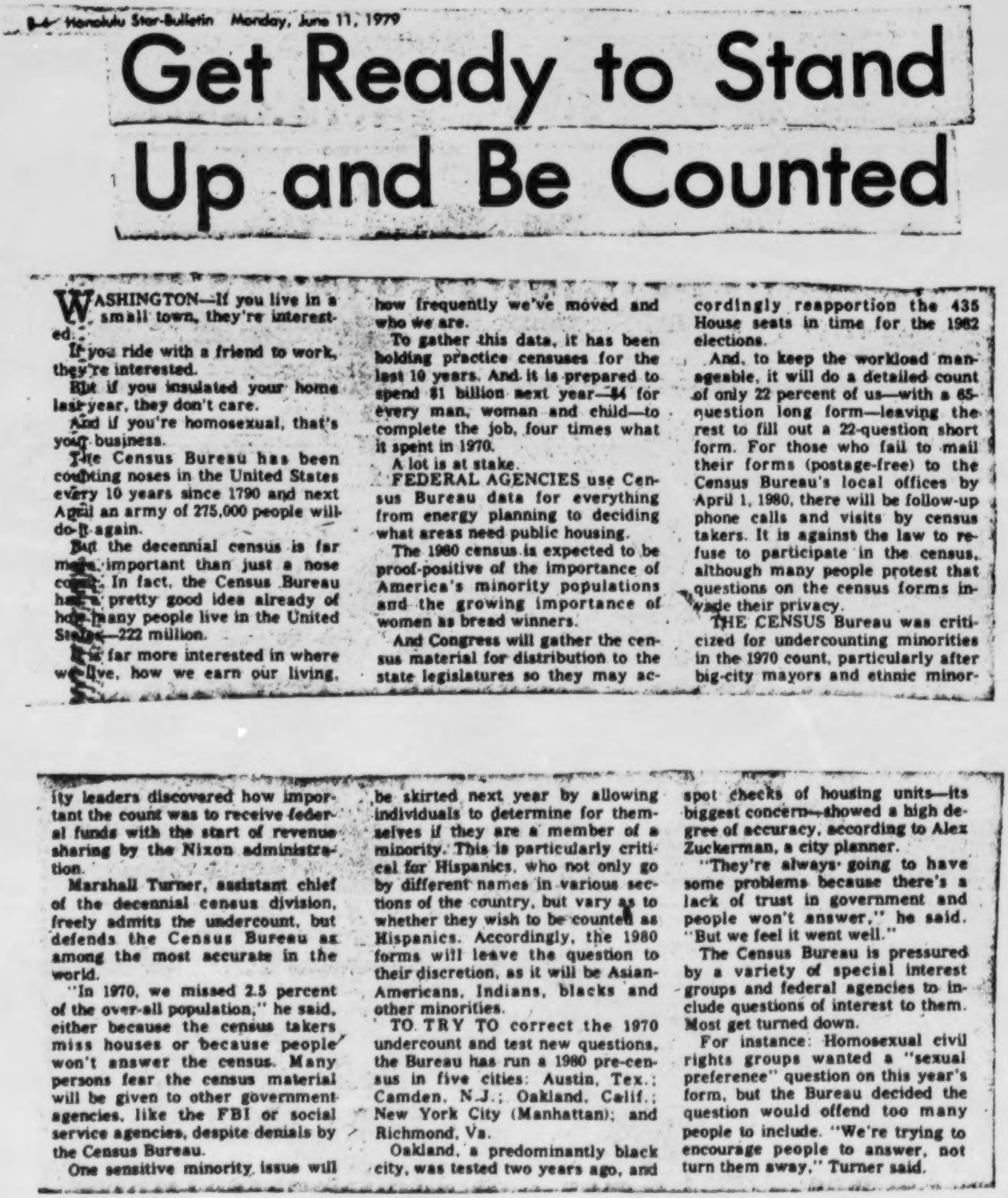
READING THE TEXTBOOK

Refer to your textbook to answer the following questions:

1. What is the title of the book?
2. Who is the author?
3. Who published the book?
4. How recent is the book?
5. How many chapters does the book contain?
6. What is the title of Chapter 9?
7. On what page does Chapter 3 begin?
8. On what page is the letter "To The Student"?
9. In the Appendix, what is Table II?
10. In each chapter there is a section called "Preview." What does this section do?
11. What section precedes the Mastery Tests in each chapter?
12. What is the answer to exercise 3a, page 92?
13. On what page is the term variance defined?
14. What word is described by Definition 3.2?
15. What does the symbol σ mean?
16. What formula is given by $\frac{B + \frac{1}{2}E}{n} \cdot 100$?

Chapter 1, Lesson 1

Worksheet 2



B-4 Honolulu Star-Bulletin Monday, June 11, 1979

Get Ready to Stand Up and Be Counted

WASHINGTON—If you live in a small town, they're interested.

If you ride with a friend to work, they're interested.

But if you insulated your home last year, they don't care.

And if you're homosexual, that's your business.

The Census Bureau has been counting noses in the United States every 10 years since 1790 and next April an army of 275,000 people will do it again.

But the decennial census is far more important than just a nose count. In fact, the Census Bureau has a pretty good idea already of how many people live in the United States—222 million.

It is far more interested in where we live, how we earn our living, how frequently we've moved and who we are.

To gather this data, it has been holding practice censuses for the last 10 years. And it is prepared to spend $1 billion next year—$4 for every man, woman and child—to complete the job, four times what it spent in 1970.

A lot is at stake.

FEDERAL AGENCIES use Census Bureau data for everything from energy planning to deciding what areas need public housing.

The 1980 census is expected to be proof-positive of the importance of America's minority populations and the growing importance of women as bread winners.

And Congress will gather the census material for distribution to the state legislatures so they may accordingly reapportion the 435 House seats in time for the 1982 elections.

And, to keep the workload manageable, it will do a detailed count of only 22 percent of us—with a 65-question long form—leaving the rest to fill out a 22-question short form. For those who fail to mail their forms (postage-free) to the Census Bureau's local offices by April 1, 1980, there will be follow-up phone calls and visits by census takers. It is against the law to refuse to participate in the census, although many people protest that questions on the census forms invade their privacy.

THE CENSUS Bureau was criticized for undercounting minorities in the 1970 count, particularly after big-city mayors and ethnic minority leaders discovered how important the count was to receive federal funds with the start of revenue sharing by the Nixon administration.

Marshall Turner, assistant chief of the decennial census division, freely admits the undercount, but defends the Census Bureau as among the most accurate in the world.

"In 1970, we missed 2.5 percent of the over-all population," he said, either because the census takers miss houses or because people won't answer the census. Many persons fear the census material will be given to other government agencies, like the FBI or social service agencies, despite denials by the Census Bureau.

One sensitive minority issue will be skirted next year by allowing individuals to determine for themselves if they are a member of a minority. This is particularly critical for Hispanics, who not only go by different names in various sections of the country, but vary as to whether they wish to be counted as Hispanics. Accordingly, the 1980 forms will leave the question to their discretion, as it will be Asian-Americans, Indians, blacks and other minorities.

TO TRY TO correct the 1970 undercount and test new questions, the Bureau has run a 1980 pre-census in five cities: Austin, Tex.; Camden, N.J.; Oakland, Calif.; New York City (Manhattan); and Richmond, Va.

Oakland, a predominantly black city, was tested two years ago, and spot checks of housing units—its biggest concern—showed a high degree of accuracy, according to Alex Zuckerman, a city planner.

"They're always going to have some problems because there's a lack of trust in government and people won't answer," he said. "But we feel it went well."

The Census Bureau is pressured by a variety of special interest groups and federal agencies to include questions of interest to them. Most get turned down.

For instance: Homosexual civil rights groups wanted a "sexual preference" question on this year's form, but the Bureau decided the question would offend too many people to include. "We're trying to encourage people to answer, not turn them away," Turner said.

Chapter 1, Lesson 1

Transparency

1. Between Dec. 1978 and Feb. 1979, the Multiple Listing Service reported that 19.5% of all single family houses sold in Hawaii cost between $100,000 and $124,999.

2. On Sept. 30, 1978, the Honolulu Advertiser gave the results of a pre-primary election poll for the office of state governor: Mayor Fasi had a 10 point lead over Governor Ariyoshi.

3. The Department of Labor reported a 6.7% unemployment rate for the State of Hawaii in May, 1979.

4. Hawaiian Telephone reported that Kauai had 3.9% of all telephones in service in Hawaii in Dec., 1978.

Chapter 1, Quiz 1 Name______________________________

Date Due:_________________________

Find five examples of statistics in use. Possible sources include newspapers, magazines, and television. For each example complete the questions below. The original examples or accurate quotes or descriptions should be stapled to this quiz paper. Some of the questions are expanded upon below.

Where Located: Where did you find this example? The 6:00 news on Channel 4? The Honolulu Star-Bulletin? *Time* magazine? Be specific.

Date: What is the date of this newspaper/magazine/newscast/etc.?

Description: Identify the example by title or by content. (E.g., article entitled "Stock Loss Worst of Year," ad for Nike running shoes, quote from sportscaster concerning Rainbow Wahines game)

Example 1

Where Located:____________________________ Date:____________________

Description:____

____

Type of Statistics: Descriptive Inferential (circle one)

Population: ____

Sample: ____

Explain why this is an example of descriptive/inferential statistics
(be specific):____

____

Example 2

Where Located:____________________________ Date:____________________

Description: ____

____

Type of Statistics: Descriptive Inferential (circle one)

Population: ____

Sample: ____

Explain why this is an example of descriptive/inferential statistics
(be specific):____

____

Example 3

Where Located: ____________________ Date: ______________

Description: ____

____

Type of Statistics: Descriptive Inferential (circle one)

Population: ____

Sample: ____

Explain why this is an example of descriptive/inferential statistics (be specific): ____

____

Example 4

Where Located: ____________________ Date: ______________

Description: ____

____

Type of Statistics: Descriptive Inferential (circle one)

Population: ____

Sample: ____

Explain why this is an example of descriptive/inferential statistics (be specific): ____

____

Example 5

Where Located: ____________________ Date: ______________

Description: ____

____

Type of Statistics: Descriptive Inferential (circle one)

Population: ____

Sample: ____

Explain why this is an example of descriptive/inferential statistics (be specific): ____

____

Chapter 2, Lesson 1
Worksheet 1

Name ______________________

Date ______________________

1. Complete the frequency distribution for the given decimal digits of π.

π = 3.14159 26535 89793 23846 26433 83279 50288 41971

69399 37510 58209 74944 59230 78164 06286 20899

86280 34825 34211 70679 82148 08651 32823 06647

DECIMAL DIGITS OF π:

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
No.	Tally	Frequency f_i	Cumulative Frequency (c.f.)	Relative Frequency (r.f. or %)	Cumulative Per Cent (c %)
i=0					
i=1					
i=2					
i=3					
i=4					
i=5					
i=6					
i=7					
i=8					
i=9					

Chapter 2, Lesson 1
Worksheet 1 - Page 2

2. Make a tally of the letters occuring in this paragraph. The first word, "If", has been done for you.

> "If you awoke one day to discover that you had been put on a strange island, your first project after getting food and water would be to try to find out where you were. This is just what has happened to all of us. We have all been born on an island in space: the earth, We are all passengers on a cosmic journey. Astronomy is the process of finding out where we are."*

PARAGRAPH LETTER FREQUENCY

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
Letter	Tally	Frequency f	Cumulative Frequency** (c.f.)	Relative Frequency (r.f.)	Cumulative Percent (c %)
A					
B					
C					
D					
E					
F	|				
G					
H					
I	|				
J					
K					
L					
M					
N					
O					
P					
Q					
R					
S					
T					
U					
V					
W					
X					
Y					
Z					

a. What are the five most frequently occuring letters? ____________

b. What are the five least frequently occuring letters? ____________

---

*Hartman, W. J. Astronomy: the Cosmic Journey. Belmont, California: Wadsworth, 1978, p. 2.

**In this problem cumulative frequency is found by totaling the number of times a specific letter occurs and the number of times that letters preceding it in the alphabet occur.

Chapter 2, Lesson 2 Name____________________________

Worksheet 2 Date____________________________

According to studies done by cryptographers, the letter E is the most frequently used letter in the English language. Here is a list of all 26 letters in decreasing order of use. Letters grouped by parentheses have about the same relative frequency in the English language.

E T (A O) N (I R) (S H) D L (C U M) (F P Y) (W G B) V (K X J) (Q Z)

How does this list compare to your results from Exercise 2?

____

Methods of statistics can be used to help in deciphering secret messages. This is of great importance in national security!

Use the information about frequency of letters used in the English language to solve the following cipher! Hints are given below.

CBK BNZOKWC CBUGA VMZ

CIM LKMLPK CM OM UW

CM FKKL N WKEZKC.

1. Make a frequency table for the letters used in this code. Which letter occurs most frequently? Is there a good chance this letter represents an E?

2. What are the only one-letter words in the English language? Does either of these words appear in the code?

3. A very common word in the English language is THE. Do you think it appears in this code?

4. What are some common two-letter words? Could any of these be in the cipher?

5. Keep in mind that ETAON are the five most frequently occurring letters in the alphabet. Some of the most frequently occurring letters in the code will probably match up!

6. GOOD LUCK!

DECIMAL DIGITS OF π:

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
No.	Tally	Frequency (f_i)	Cumulative Frequency (c.f.)	Relative Frequency (r.f.)	Cumulative Percent (c %)
i=0	𝍸 𝍸	10			
i=1	𝍸 𝍸	10			
i=2	𝍸 𝍸 𝍸	15			
i=3	𝍸 𝍸 |||	13			
i=4	𝍸 𝍸 ||	12			
i=5	𝍸 ||||	9			
i=6	𝍸 𝍸 ||	12			
i=7	𝍸 ||||	9			
i=8	𝍸 𝍸 𝍸 |	16			
i=9	𝍸 𝍸 ||||	14			

Chapter 2, Lesson 4
Transparency

HOURLY SALARIES FOR STUDENTS' PART-TIME JOBS

$3.10	3.80	3.55	3.80	3.10
3.40	4.00	3.25	3.55	3.30
3.50	3.30	3.25	3.10	3.20
3.75	3.45	3.85	4.05	3.25
3.10	3.25	3.70	3.10	4.00

HOURLY SALARIES FOR STUDENTS' PART-TIME JOBS

Class Number	Amount	Class Mark	Tally	Frequency	Relative Frequency
1	$3.10-3.25				
2	$3.25-3.40				
3	$3.40-3.55				
4	$3.55-3.70				
5	$3.70-3.85				
6	$3.85-4.00				
7	$4.00-4.15				

Chapter 2, Lesson 4 Name______________________

Worksheet 3 Date______________________

1. Find the class mark for each of the following intervals.

   a. 18 - 22
   b. 7 - 15
   c. 6 - 11
   d. 41 - 44
   e. 21 - 33
   f. 13 - 51
   g. 1,084 - 1,213

2. The lowest score in a distribution is 21 and the highest score is 85. List the intervals you would use to set up an 8 class frequency distribution. (Hint: First find class size.)

3. The lowest score in a distribution is 6 and the highest score is 45. The class intervals are all the same size. If one of them is 26-29 how many classes are there?

4. List intervals that could be used in a 10-class frequency distribution if the high and low scores are 203 and 86 respectively.

AGE AT WHICH 150 WOMEN IN N.Y.C. MARRIED FOR FIRST TIME					
Class Number	Ages	Class Mark	Tally	f_i	r.f.
i=0	14 -				
i=1					
i=2					
i=3					
i=4					

AGE AT WHICH 150 WOMEN IN N.Y.C. MARRIED FOR FIRST TIME					
Class Number	Ages	Class Mark	Tally	f_i	r.f.
i=1	14 -				
i=2					
i=3					
i=4					
i=5					
i=6					
i=7					
i=8					
i=9					
i=10					
i=11					
i=12					
i=13					
i=14					
i=15					

Chapter 2, Quiz 1

Name ____________________

Date ____________________

1. Complete the following frequency distribution:

GRADES IN STATISTICS EXAM

Grade	Frequency	Cumulative Frequency *	Relative Frequency
A		50	
B		41	
C		31	
D		11	
F		3	

*Number of scores equal to or lower than given score

2. The class mark of the interval 20-23 is ____________.

3. The lowest score in a distribution is 15 and the highest score is 86. If the scores are to be grouped into 8 class intervals, what will the of each interval be? ____________________

4. The lowest score in a distribution is 18 and the highest is 56, The class intervals are all the same size, One of them includes the scores 22-25. How many classes are there?

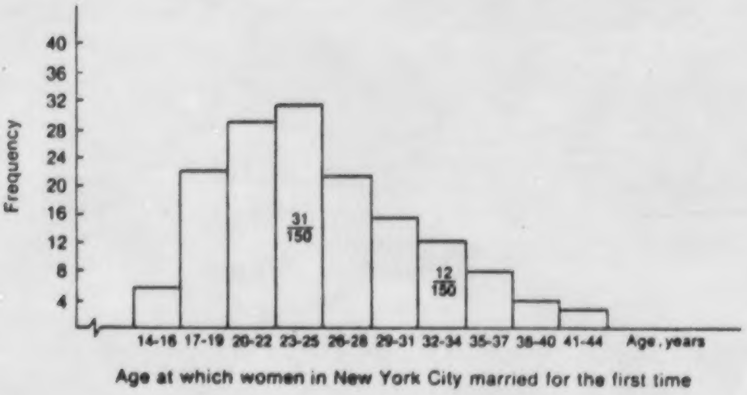
5. Construct a frequency distribution for the following data. It should have 8 class intervals and should include class mark, relative frequency and cumulative percent.

NUMBER OF INCOMING CALLS AT SWITCHBOARD 3

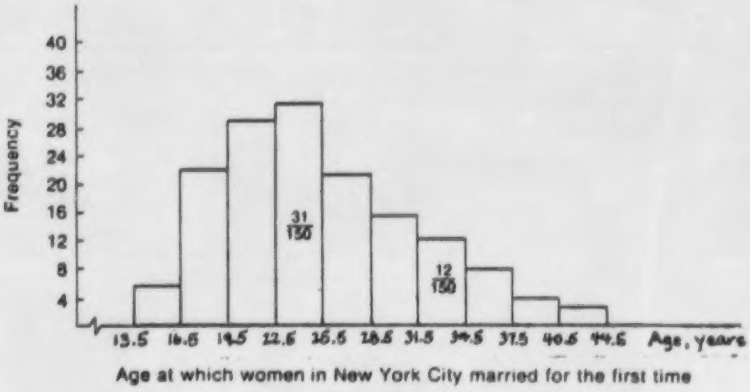
31	39	51	47	38	42	33	40	49	53
50	32	48	37	31	43	35	52	39	53
36	46	53	39	41	30	37	44	33	32
37	50	35	51	47	38	36	37	51	53
44	47	39	38	43	52	46	30	42	45

Chapter 2, Lesson 7
Transparency

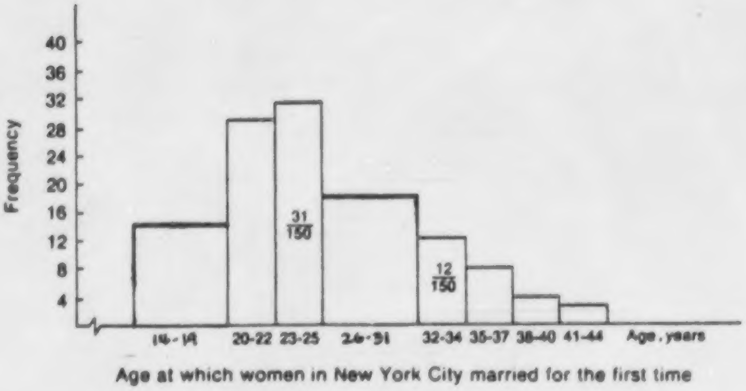
Original:



Labeling with
class boundaries:



Histogram with
rectangles of
different widths:

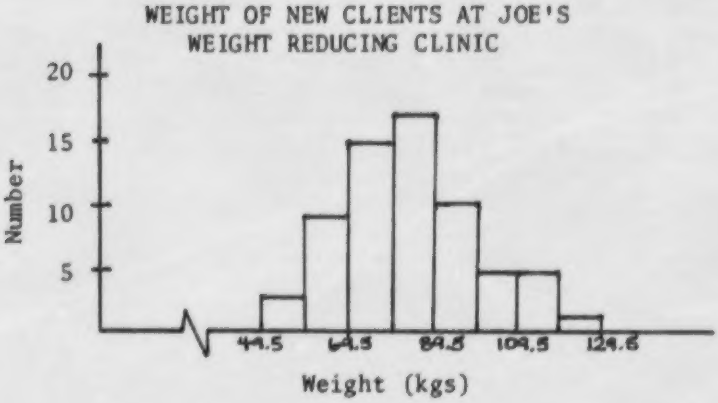


Chapter 2, Quiz 2

Name____________________________

Date____________________________

1.



a. How many of Joe's new clients weighed between 60 and 69 kilograms?

____

b. How many of Joe's new clients weigh 90 kilograms or more? ________

c. How many new clients does Joe have at his clinic? ________

2. Construct a histogram using intervals of 5 kg. The following are the weights (in kilograms) of 40 players on the high school football team. Show all work!

85, 97, 85, 89, 76, 85, 85, 90, 74, 103, 88, 106, 90, 96, 85, 107, 93,

81, 87, 97, 106, 99, 93, 84, 82, 91, 97, 70, 77, 105, 98, 85, 90, 87,

76, 75, 94, 74, 78, 85.

Chapter 2, Lesson 9
Worksheet 4

Name ______________________

Date ______________________

Convert each of the following fractions to decimals. Round your answer to three decimal places.

1. $\frac{2}{10}$

2. $\frac{1}{4}$

3. $\frac{13}{78}$

4. $\frac{5}{16}$

5. $\frac{7}{150}$

6. $\frac{294}{310}$

7. $\frac{.5}{8}$

8. $\frac{6\frac{1}{2}}{26}$

Multiply

9. .2 x 360

10. .17 x 360

11. .5 x 28

12. .75 x 100

13. .89 x 16

14. 1.08 x 5

15. .3 x .2

16. .6 x 360

Write each of the following decimals as a percent

17. .83

18. .254

19. .3871

20. 1.03

21. .0567

22. .4

23. 2

24. 1.6

Write each of the following percents as decimals

25. 54%

26. 27.8%

27. 36.04%

28. 7%

29. 1.9%

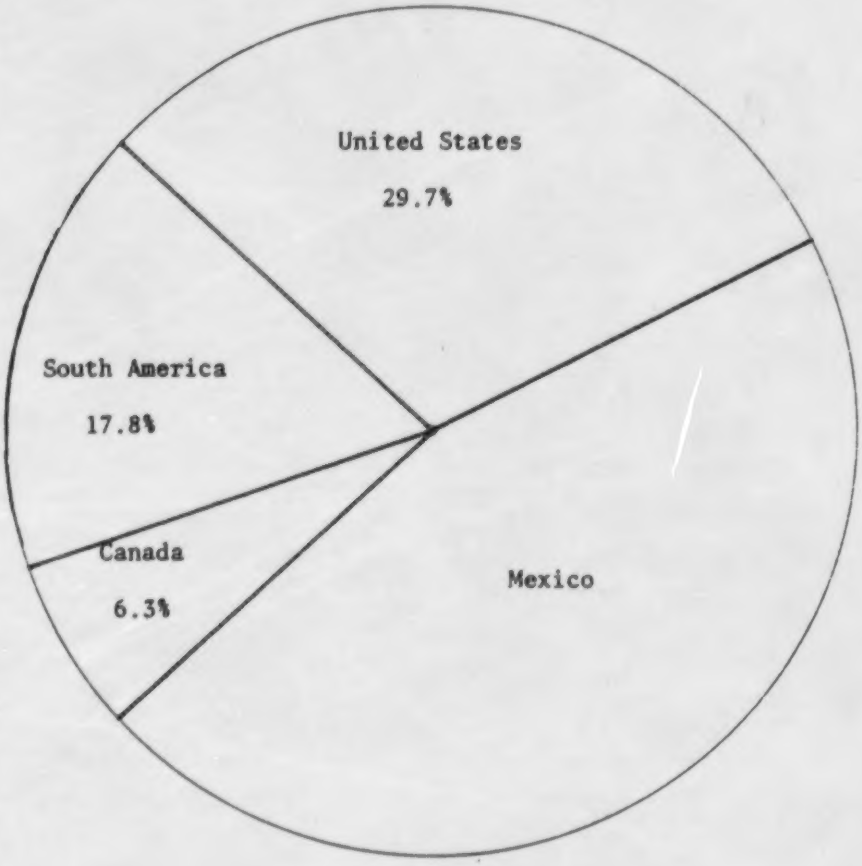
30. 156%

31. 8.3%

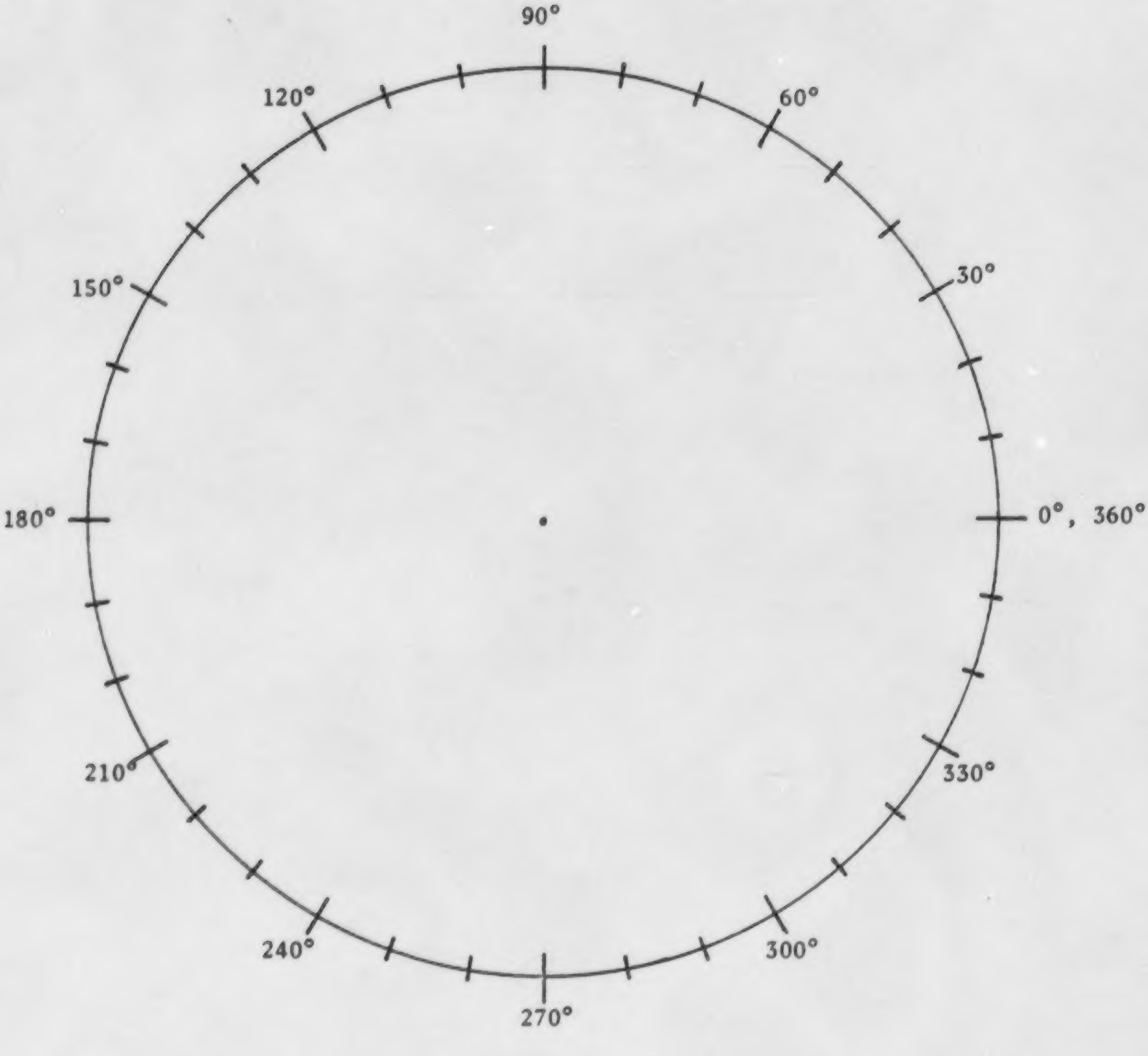
32. .91%

Chapter 2, Lesson 10
Transparency

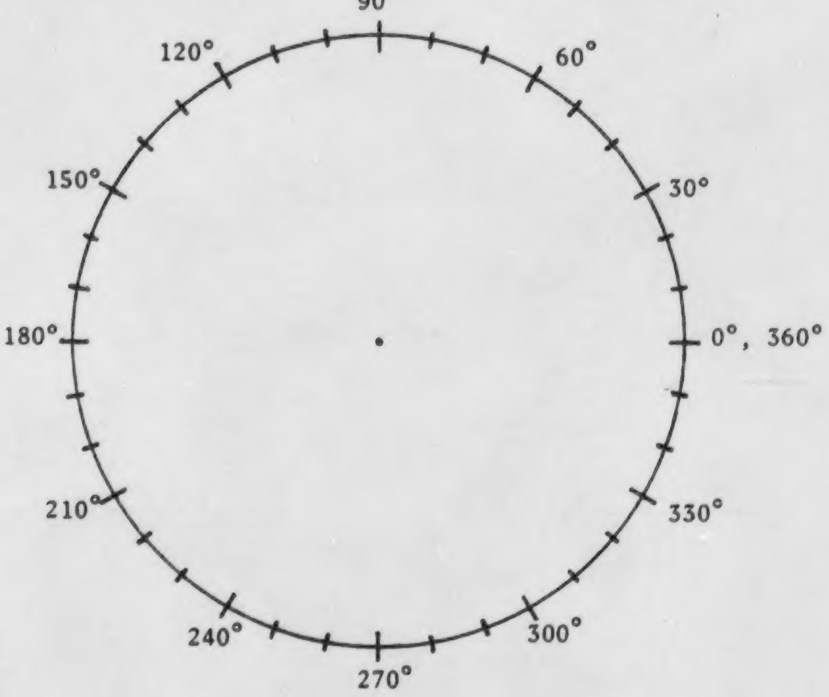
DISTRIBUTION OF BARRELS OF OIL IN THE WESTERN HEMISPHERE



Chapter 2, Lesson 11
Transparency A

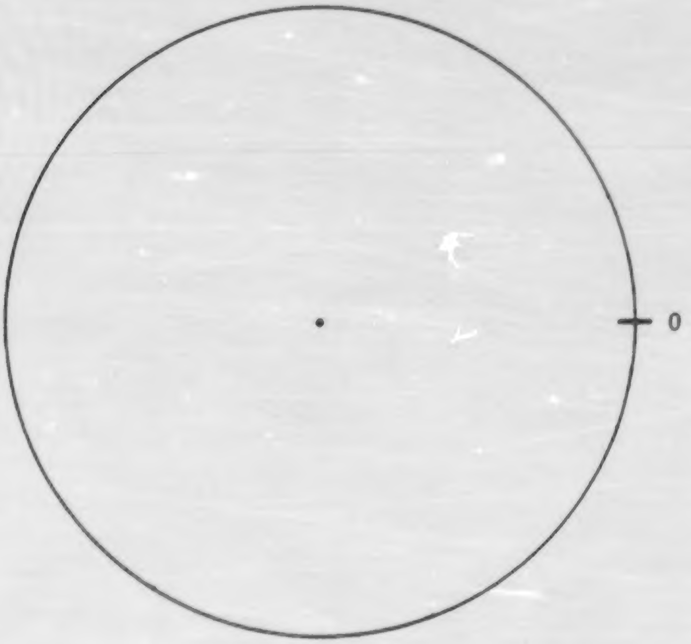

90°
120°
60°
150°
30°
180°
0°, 360°
210°
330°
240°
300°
270°

Chapter 2, Lesson 11
Transparency B


90°
120°
60°
150°
30°
180°
0°, 360°
210°
330°
240°
300°
270°

Telephones in Service in Hawaii by Counties:
(Dec. 21, 1978)

County	%	Degrees
Oahu	79.4%	286°
Kauai	3.9%	14°
Maui	7.8%	28°
Hawaii	8.9%	32°



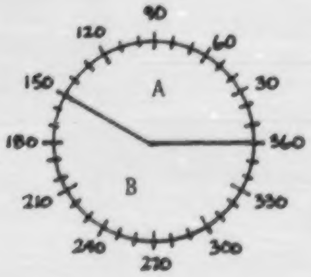
1978 Receipts for Honolulu Marathon Association

	%	Degrees
Race Entry Fees	37.7%	136°
News Letter Subscription	6.7%	24°
Shirt Sales	22.2%	80°
Sponsorships and Contributions	17.2%	62°
Others	16.2%	58°

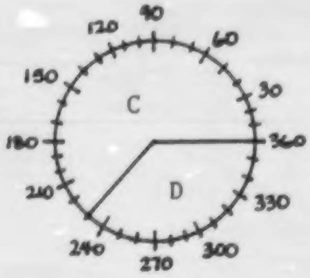
Chapter 2, Lesson 11 Name______________________

Worksheet 5 Date______________________

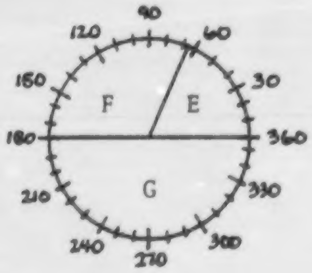
1. Find the angle measure for each of the following.



90
120
60
150
30
A
180
360
B
210
330
240
300
270



90
120
60
150
30
C
180
360
D
210
330
240
300
270



90
120
60
150
30
F
E
180
360
G
210
330
240
300
270

a. A = _____°

B = _____°

b. C = _____°

D = _____°

c. E = _____°

F = _____°

G = _____°

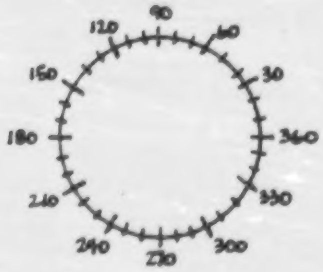
2. Draw central angles in each circle as indicated.

a. H = 45°
I = 315°

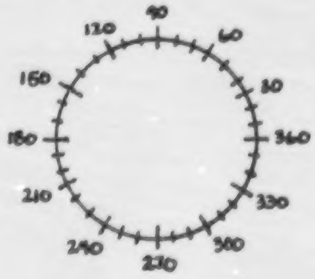
b. J = 75°
K = 120°
L = 165°

c. M = 110°
N = 90°

The remaining central angle
P = _____°



90
120
60
150
30
180
360
210
330
240
300
270



90
120
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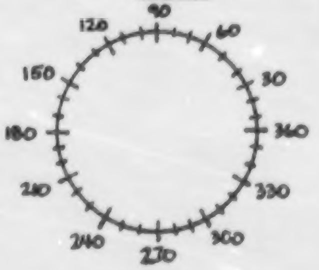
150
30
180
360
210
330
240
300
270



90
120
60
150
30
180
360
210
330
240
300
270

d. Q = 30°
R = 210°

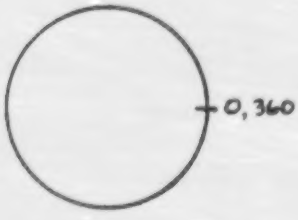
The remaining central angle
S = _____°

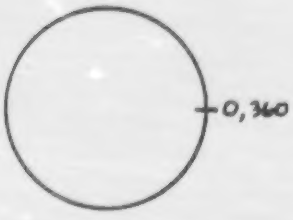
e. T = 70°
U = 80°

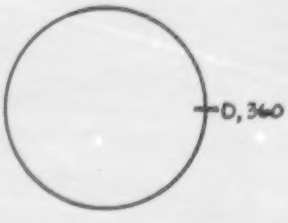
The remaining central angle
W = _____°

f. X = 225°
Y = 70°

The remaining central angle
Z = _____°







3. Construct a circle graph for the following information.

Grades in Mrs. Abelson's class		
Grade	%	Degrees
A	8	28.8
B	28	100.8
C	32	115.2
D	20	72
F	12	43.2

If there are 25 students in Mrs. Abelson's class, how many of them received

a. an A? _____ c. a C? _____

b. a B? _____ d. a D? _____

71

Chapter 2, Lesson 12
Transparency

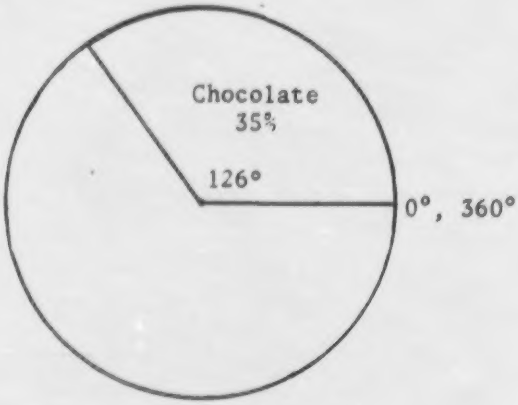
Pints of Ice Cream Sold at J's in August

Flavor	No.
Chocolate	1225
Vanilla	1050
Butterscotch	175
Mint Chocolate Chip	525
Coffee	525

First calculate:

Flavor	#	Relative Frequency (as decimal)	Central Angle Measurement
Chocolate	1225	$\frac{1225}{3500} = .35$	$.35 \times 360° = 126°$
Vanilla	1050		
Butterscotch	175		
Mint Chocolate Chip	525		
Coffee	525		
TOTAL =	3500		

Then construct graph:



Be sure to label each piece as well as the graph itself!

Chapter 2, Quiz 3

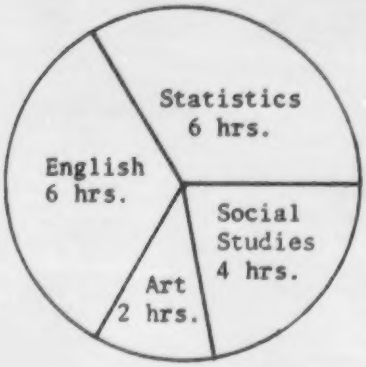
Name ______________________

Date ______________________

1. Change $\frac{5}{16}$ to a decimal.

2. Multiply: .2 x .4

Use the circle chart below to answer questions 3 and 4.



Number of Hours
Marie Spends Studying
Each Week

3. ______% of time is spent studying statistics.

4. The angle which forms the "wedge" for English should measure ______ degrees.

5. In a recent local race, 27% of the entrants qualified for the associated regional meet. If 63 people competed, how many of them can race in the regional meet?

6. Construct a circle graph for the following data. Show all work!

State Population by County July 1, 1975		Relative Frequency	Central Angle Measure
Honolulu	704,500	$\frac{704500}{864900}$=.815	293°
Hawaii	74,700	.086	31°
Maui	53,900	.062	22°
Kauai	31,800	.037	13°
TOTAL = 864,900			

Chapter 2, Lesson 14
Worksheet 6

Name________________________

Date________________________

Following is a grouped frequency distribution of the results of 80 students on a final exam:

FINAL EXAM RESULTS

class	interval	true limits (class boundary)	class mark	f	cf	c%
1	45 - 49			1		
2	50 - 54			0		
3	55 - 59			4		
4	60 - 64			7		
5	65 - 69			13		
6	70 - 74			17		
7	75 - 79			16		
8	80 - 84			11		
9	85 - 89			6		
10	90 - 94			3		
11	95 - 99			2		

Complete the table and draw a frequency polygon. Does the data appear to be normally distributed?

Chapter 2, Lesson 15
Worksheet 7

1. Construct a frequency distribution and a frequency polygon for the following data. Is the graph a normal curve?

IQ SCORES OF 110 HIGH SCHOOL STUDENTS SELECTED AT RANDOM

154	131	122	100	113	119	121	128	112	93
133	119	115	117	110	104	125	85	120	135
116	103	103	121	109	147	103	113	107	98
128	93	90	105	118	134	89	143	108	142
85	108	108	136	115	117	110	80	111	127
100	100	114	123	126	119	122	102	100	106
105	111	127	108	106	91	123	132	97	110
150	130	87	89	108	137	124	96	111	101
118	104	127	94	115	101	125	129	131	110
97	135	108	139	133	107	115	83	109	116
110	113	112	82	114	112	113	142	145	123

2. Below are the scores of two groups of sophomore students on a test of reading ability.

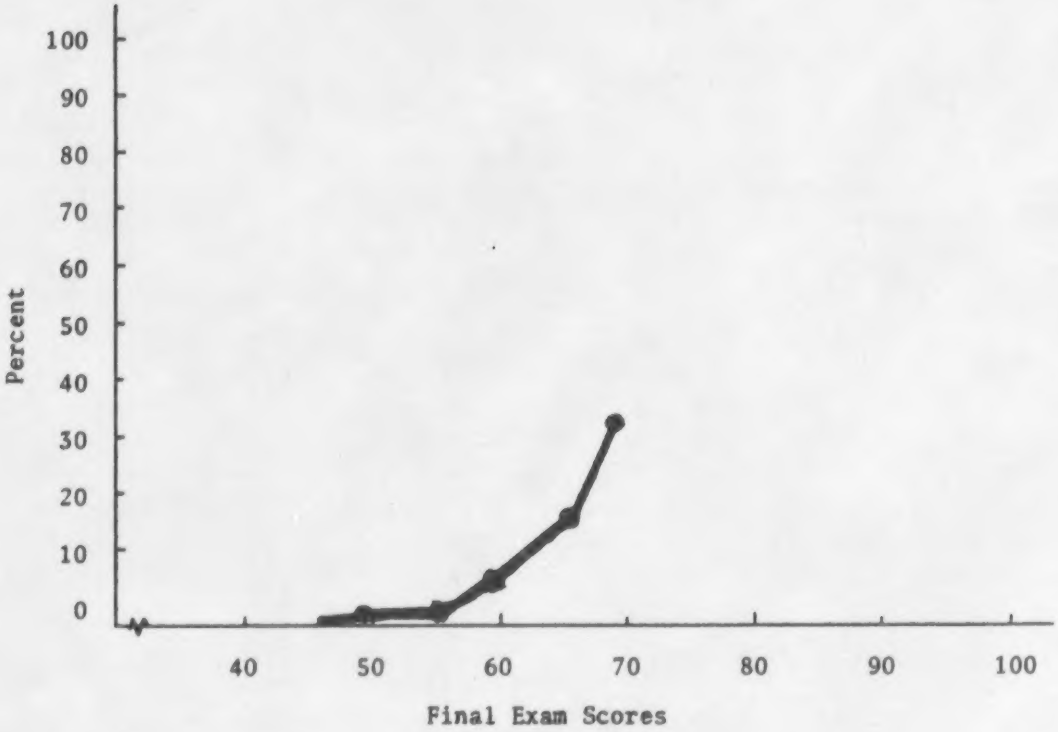
Interval	Frequency (Group A)	Frequency (Group B)
14 - 16	2	2
17 - 19	1	4
20 - 22	3	6
23 - 25	4	9
26 - 28	6	11
29 - 31	9	21
32 - 34	13	34
35 - 37	19	23
38 - 40	28	12
41 - 43	20	8
44 - 46	18	5
47 - 49	12	3
50 - 52	5	2

a. Construct a frequency polygon for each group on one set of axes.

b. Which group appears to have the better ability?

Chapter 2, Lesson 16
Transparency

Interval	True Limits	f	cf	c%
45 - 49	44.5 - 49.5	1	1	1.25
50 - 54	49.5 - 54.5	0	1	1.25
55 - 59	54.5 - 59.5	4	5	6.25
60 - 64	59.5 - 64.5	7	12	15.00
65 - 69	64.5 - 69.5	13	25	31.25
70 - 74	69.5 - 74.5	17	42	52.50
75 - 79	74.5 - 79.5	16	58	72.50
80 - 84	79.5 - 84.5	11	69	86.25
85 - 89	84.5 - 89.5	6	75	93.75
90 - 94	89.5 - 94.5	3	78	97.50
95 - 99	94.5 - 99.5	2	80	100.00

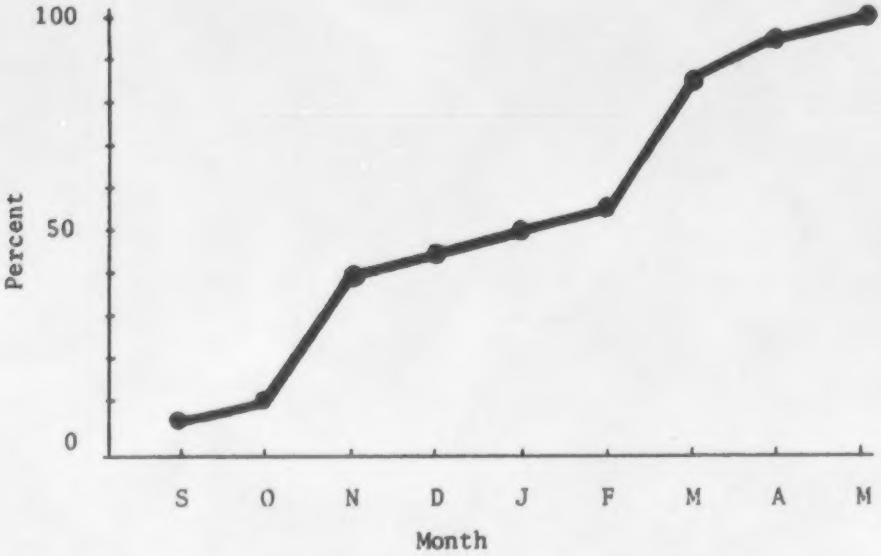


Chapter 2, Lesson 16
Worksheet 8

Name________________________

Date________________________

1.



Funds Raised by Seniors During School Year

a. By November approximately what percent of the funds had been raised?

b. Approximately what percent of the funds was raised between March and April?

c. When had approximately 50% of the funds been raised?

2. The ages of children at a certain school are as follows:

Age	Number
13	37
14	23
15	44
16	46
17	42
18	48
19	37

Construct the ogive for this distribution.

77

3. Construct an ogive for Exercise 1, Worksheet 6.

4. Construct an ogive for the combined group data in Exercise 2, Worksheet 6.

Chapter 2, Lesson 18
Worksheet 9

Name____________________

Date____________________

GRAPHING PROJECT

This project must be turned in (neatness counts). It should include a Title Page and a Table of Contents. The data and these directions should be attached to the final report.

1. Using Data Number 1
   a. Make a frequency distribution that includes midpoint, true limits, relative frequency, cumulative frequency, and cumulative percent.
   b. Make a histogram, frequency polygon, and ogive for this data.
2. Using Data Number 2 repeat steps 1a and 1b.

Data Number 1: Age of Hawaii Population (1970 census)

Age in Years	Frequency (to nearest 1,000)
under 5	71
5 - 9	80
10 - 14	80
15 - 19	72
20 - 24	82
25 - 29	60
30 - 34	48
35 - 39	47
40 - 44	49
45 - 49	46
50 - 54	38
55 - 59	30
60 - 64	23
65 - 69	18
70 - 74	12
75 and over	14

Chapter 2, Lesson 18
Worksheet 9, page 2

Data Number 2:

Following are the number of credit hours 205 of the students at one university had earned.

47	135	49	46	86	32	30	150	134	90
70	82	23	117	49	150	129	45	43	56
95	24	118	137	161	28	25	42	29	40
32	95	48	0	43	135	27	0	0	47
64	100	26	67	26	90	15	46	80	31
23	0	45	30	15	91	88	31	15	20
62	83	88	20	138	0	0	91	22	44
39	176	0	38	65	45	86	53	45	53
31	36	25	55	23	76	12	90	96	75
45	55	46	92	42	48	88	40	40	38
45	12	99	15	150	129	56	16	16	0
0	28	14	56	45	45	2	90	12	60
47	46	45	69	76	45	60	42	81	50
52	10	43	65	85	70	40	32	87	45
90	6	47	45	7	20	64	50	98	86
60	49	58	15	68	87	0	50	0	15
86	60	15	50	47	15	18	0	15	162
100	16	123	40	80	80	13	27	16	44
12	0	3	0	93	43	90	30	101	0
40	92	4	173	0	34	0	40	15	10
44	61	26	36	7					

Statistics Test Name____________________________

Chapter 2 Date____________________________

1. Give a reason for presenting data with graphs.

____

____

True or False (#2-7).

2. _____ The bars in a histogram should be touching rather than separated.

3. _____ An ogive graphs cumulative percent on the vertical (up-and-down) axis.

4. _____ A piece of the circle graph that represents $\frac{1}{4}$ of the total would be pictured with a 25 degree angle.

5. _____ Overlapping classes are used in a frequency distribution to prevent possible gaps between the classes.

6. _____ A class mark is the midpoint of a class interval.

7. _____ Bar graphs are used to graph continuous data.

Multiple choice (#8-12).

8. A good graphical display (histogram, frequency polygon, etc.) includes all but which of the following?

   a. title
   b. labels and/or scales
   c. a picture or drawing
   d. 3 or 4 lines of footnotes

9. A reasonable display for showing the U.S. civilian labor force, in millions, for each of the years 1960-1976 would be

   a. pie chart
   b. pictograph
   c. ogive
   d. none of the above

10. By taking the difference between two successive midpoints one can find the

    a. interval width
    b. true limits
    c. cumulative frequency
    d. relative frequency

11. The lowest score in a distribution is 19 and the highest score is 82, Scores are to be grouped into 8 class intervals, What will the width of each interval be?

    a. 8 b. 9 c. 10 d. 19

12. In plotting which of the following is the upper class boundary of the interval used?

    a. frequency polygon
    b. histogram
    c. ogive
    d. bar graph

Completion:

13. What type of graph would be appropriate to display

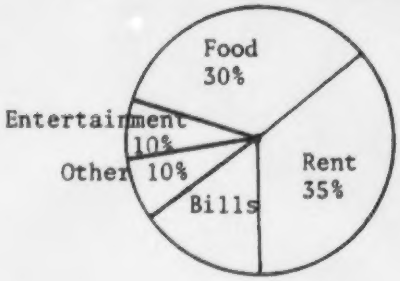
    a. the population of Hawaii's major islands?______________________________

    b. Hawaii County's harvest of macadamia nuts between 1950 and 1979?

    ____

Use the following chart to answer #14-16.

The Sakai's Family Budget



14. What percent of the Sakai's budget is spent on bills?

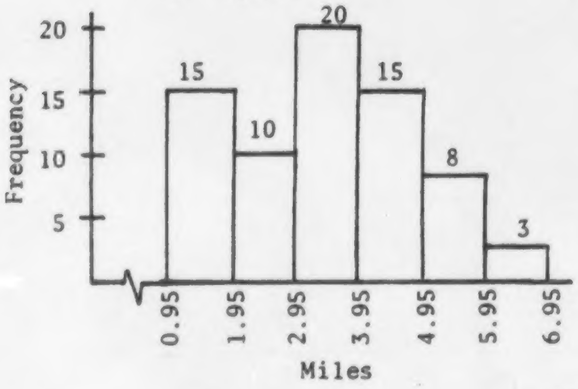
    ____

15. If their monthly income is $900, how much do they spend on rent each month? __________

16. The piece of the graph labeled Food should be _____ degrees. (This graph is not necessarily drawn accurately.)

Use the following chart to answer #17-21.

Miles Averaged on Daily Runs
by Joggers



17. What type of graph is shown for jogger's daily runs?__________

18. How many joggers are represented in the graph?________

19. What is the class width used in this graph? ______________

20. How many individuals jogged 5 miles or more?____________

21. What is the relative frequency for the third class interval?

    ____

Use the following table to answer #22-25.

YOU DO NOT NEED TO COMPLETE THE ENTIRE TABLE!

Height (in inches)	Frequency	Relative Frequency	Cumulative Frequency	Cumulative Percent
55-57	3			
58-60	5			
61-63	9		B	
64-66	15			C
67-69	10	A		
70-72	6			
73-75	2			

22. A = __________

23. B = __________

24. C = __________

25. The class mark for the second class is __________ .

26. Make a graph showing the following information:

Baseball Player's Record of Hits in July	
Type of Hit	Number
Singles	18
Doubles	9
Triples	3
Homeruns	6

83

Chapters 3 & 4, Lesson 1 Name____________________

Worksheet 1 Date____________________

1. Veronica had the second highest score on the employment test given by Clark, McCord, Hawke & Fujiama, Inc. Did she score well? __________

   Explain____

   ____

2. Atom Associates interviewed 85 candidates for employment. They intended to make job offers to the top 20%. How many people will be offered jobs?

3. George took an entrance exam for a private high school with very high academic standards. He really wanted to go to this school so he was very upset when officials told him he had scored 28 on the test. One week later George received a letter congratulating him and offering admission to the school. Did the school make a mistake? __________

   Explain____

   ____

4. Given the scores: 28, 41, 36, 35, 32, 40, 37, 28, 35, 31

   a. What is the rank from the top of score 32? __________

   b. What percent of the scores have a value below 35? __________

5. Nilo entered a recent basketball-throwing competition. He made a basket 99% of the time. The contest sponsor awarded monetary prizes to the top 10% of the contestants. Did Nilo win a prize? __________

   Explain____

   ____

6. The following scores were received on a 40 point consumer test:

   17, 21, 25, 29, 30, 34, 36, 36, 38, 39, 40, 40, 40, 40, 40

   people in the top 30% were to be offered discounts at local stores.

   a. Will the person who scored 39 out of 40 points be offered discounts? __________

   b. What percent of the test did this person do correctly? __________

Chapters 3 & 4, Lesson 2
Transparency A

SAT Math Scores & Percentile
(National H.S. Sample)

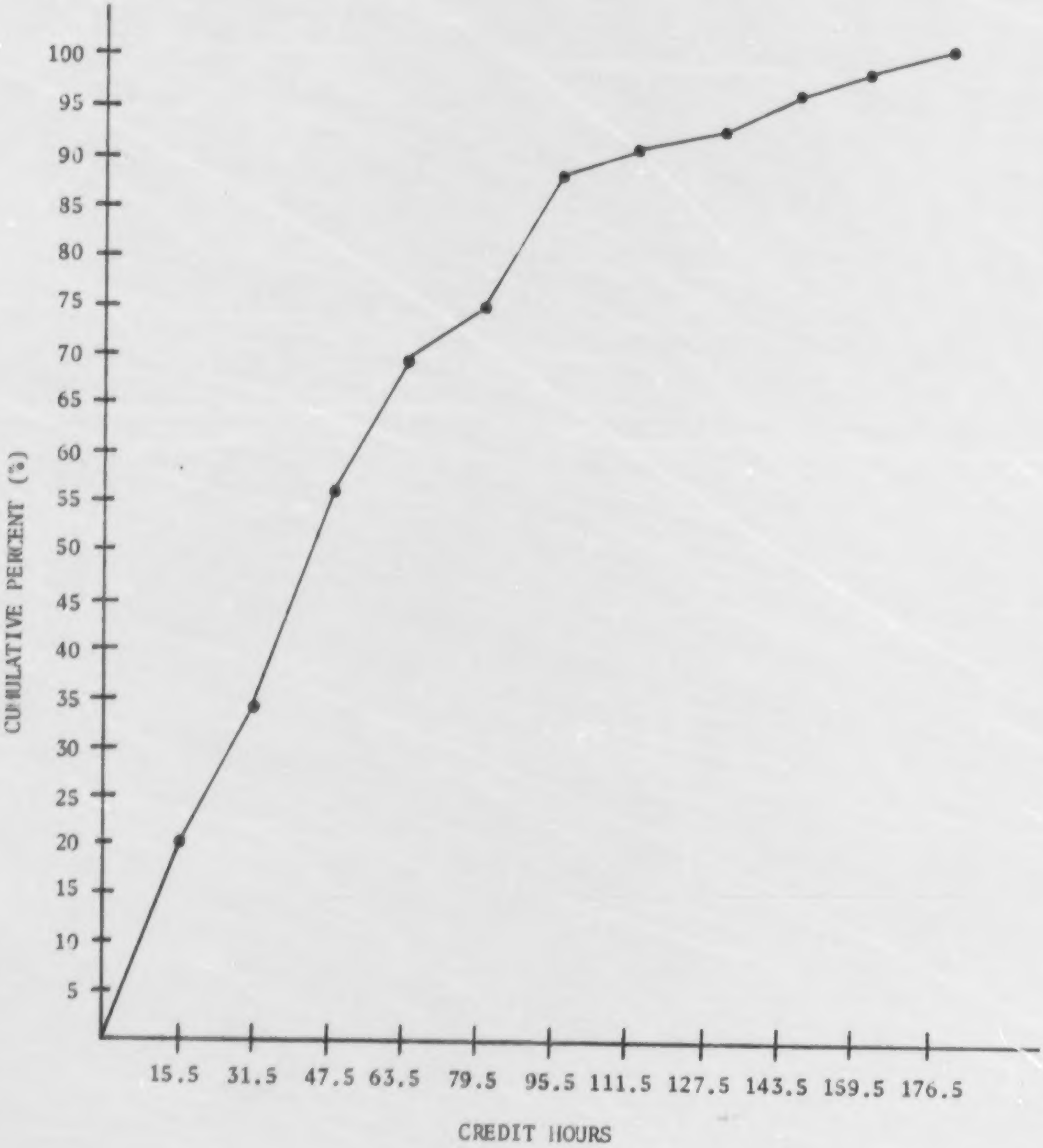
Percentile	Score
99	700
88	550
69	450
56	400
23	300
5	250

The score 450 has a percentile rank of 69. That means that someone who scored 450 did better than 69% of the people taking the test and worse than 31% of the people.

Find P_{56} . (What score has a percentile rank of 56?)

What is PR_{300}? (The score 300 has what percentile rank?)

Chapters 3 & 4, Lesson 2
Transparency B



Chapters 3 & 4, Lesson 2 Name________________________

Worksheet 2 Date________________________

Use this table to answer the following questions:

1974 OAHU FAMILIES INCOME

PERCENTILE	INCOME
2	2,000
10	5,000
25	8,500
50	15,000
75	23,000
90	31,000
95	40,000

1. About ________ percent of the families on Oahu had an income below $5,000 in 1974.

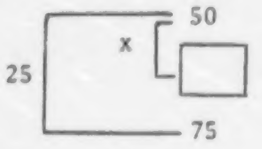
2. About ________ percent of the families on Oahu had an income above $23,000 in 1974.

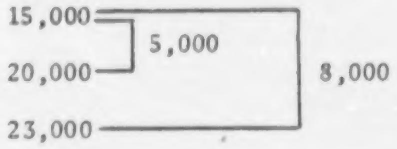
3. What percent of the families had an income between $15,000 and $31,000?

4. Does a family with an income of $20,000 come closest to the 50th, 75th or 90th percentile?

The above table can be used to approximate percentile ranks of other incomes. For example, to find the percentile rank of $20,000: Notice that $20,000 is between $15,000 and $23,000, both of which have known percentile ranks.

$20,000 is $\frac{5}{8} = \frac{5,000}{8,000}$ of the way between the two incomes as demonstrated below.





The unknown percentile rank must lie between 50 and 75. (Do you know why?) X is the difference between the unknown percentile and the 50th percentile. This means the unknown percentile rank is $\frac{x}{25}$ of the way between the two known percentiles. The two distances must be proportional. That is,

$$\frac{5}{8} = \frac{x}{25}$$

$$\text{Solve:} \quad 8x = 125$$

$$x = 15.625$$

Therefore, the percentile rank of $20,000 is approximately:

50 + 15.6 or 65.6

(Why were 50 and 15.6 added?)

5. Find the approximate percentile rank of an income of $30,000.

6. Find the approximate percentile rank of an income of $10,000.

7. Find the income of a family in the 80th percentile.

Chapters 3 & 4, Quiz 1

Name

Date

1. The people in an organization were of the following ages:

   18, 23, 27, 27, 32, 33, 34, 39, 41, 41, 41, 43, 44, 46, 46, 52, 53, 61, 63, 70

   What is the percentile rank of an age of 41?

2. In the problem above, what percent of people are age 46?

3. Tom received an 88% on his placement test. He wants to arrange an interview with Company Q. However, Company Q will not interview anyone below the 80th percentile. Is Tom sure he will be interviewed? Why or why not?

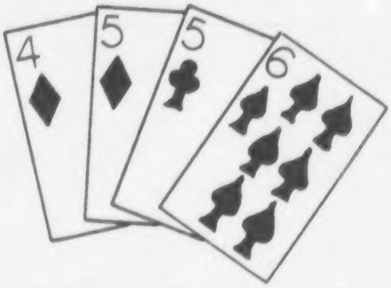
HEIGHT OF 9TH GRADE STUDENTS	
PERCENTILE	HEIGHT (INCHES)
2	54
10	56
25	58
50	60
75	62
90	63
99	66

4. What percent of students are taller than 62"?

5. What percent of students are between 56" and 62"?

6. In a recent track meet there were 20 competitors in the 50 yard dash. Brian tied with one other person for fourth place. What is Brian's percentile rank?

Chapters 3 & 4, Lesson 4
Transparency A



In a recent Cribbage game Gloria had hands which scored:

5, 10, 2, 8, 7, 12, 10, 9, 3

Find the Mean, Median, and Mode.

Ordered Scores: 2, 3, 5, 7, 8, 9, 10, 10, 12, 15

MEAN: $\bar{x} : \dfrac{2 + 3 + 5 + 7 + 8 + 9 + 10 + 10 + 12 + 15}{10} = \dfrac{81}{10} = 8.1$

MEDIAN: Since there are an even number of scores, the median is the "average" of the two middle scores

$$\frac{8 + 9}{2} = 8.5$$

MODE: 10 is the modal score. It occurs twice. All others occur once only.

CRIBBAGE SCORES: 2, 3, 5, 7, 8, 9, 10, 10, 12, 15

FIND THE MEAN, MEDIAN, AND MODE IF:

1) THE SCORE OF 15 IS REPLACED BY A SCORE OF 24

2) THE SCORE OF 5 IS REPLACED BY A SCORE OF 3

3) THE SCORE OF 9 IS REPLACED BY A SCORE OF 8

PREDICT WHETHER THE MEAN, MEDIAN, AND MODE WILL INCREASE, DECREASE, OR STAY THE SAME IF THE SCORE OF 10 IS REPLACED BY A SCORE OF 12.

Chapters 3 & 4, Lesson 5
Transparency

THE MEAN

Advantages:

1. Each score influences the mean.
2. Computation is not difficult.
3. Familiar to most people.

Disadvantages:

1. Extremely large or small scores influence the mean more than intermediate scores.
2. Takes time to compute for large distributions.

THE MEDIAN

Advantages:

1. Not influenced by extreme scores.
2. Requires only counting to determine if the scores are arranged by size.
3. The middle score (half the scores are at or below the median; half are at or above the median).

Disadvantages:

1. Does not involve each score.
2. Scores must be arranged in order of size.

THE MODE

Advantages:

1. The most common value.
2. Requires no computation to determine.

Disadvantages:

1. May not be near the center of the distribution.
2. Increasing the sample may change the mode considerably.

---

[*] From "Centers and Spreads," Oakland County (Mich.) Mathematics Project.

Chapters 3 & 4, Lesson 5 Name ______________________

Worksheet 3 Date ______________________

1. Which average (mean, median, or mode) is best for each situation? Give a reason for your choice.

   a. You need to know "average" shoe size so you can place an order for your store. ______________________

      ____

   b. You print programs for the U.H. Women's Volleyball games and are interested in knowing the "average" attendance. ______________________

      ____

   c. You want to determine the middle score on a test. ______________________

      ____

   d. Team standings for a bowling tournament are determined by computing team "averages." You need to find your team's average. ______________________

      ____

2. Which will be larger, the mean or the median age of guests at a local discotheque? Explain.

3. Leilani has worked a total of 52 hours in the last three weeks. If she wants to average 16 hours a week, how many hours must she work this week?

4. Ten people in a room have an average height of 5'6". An eleventh person, who is 6'5" tall enters the room. Find the mean height of all eleven people.

5. The number of cars in a parking lot this week (Monday - Friday) was 48, 37, 49, 59, and 40.

   a. Find the mean, median, and modal number of cars.

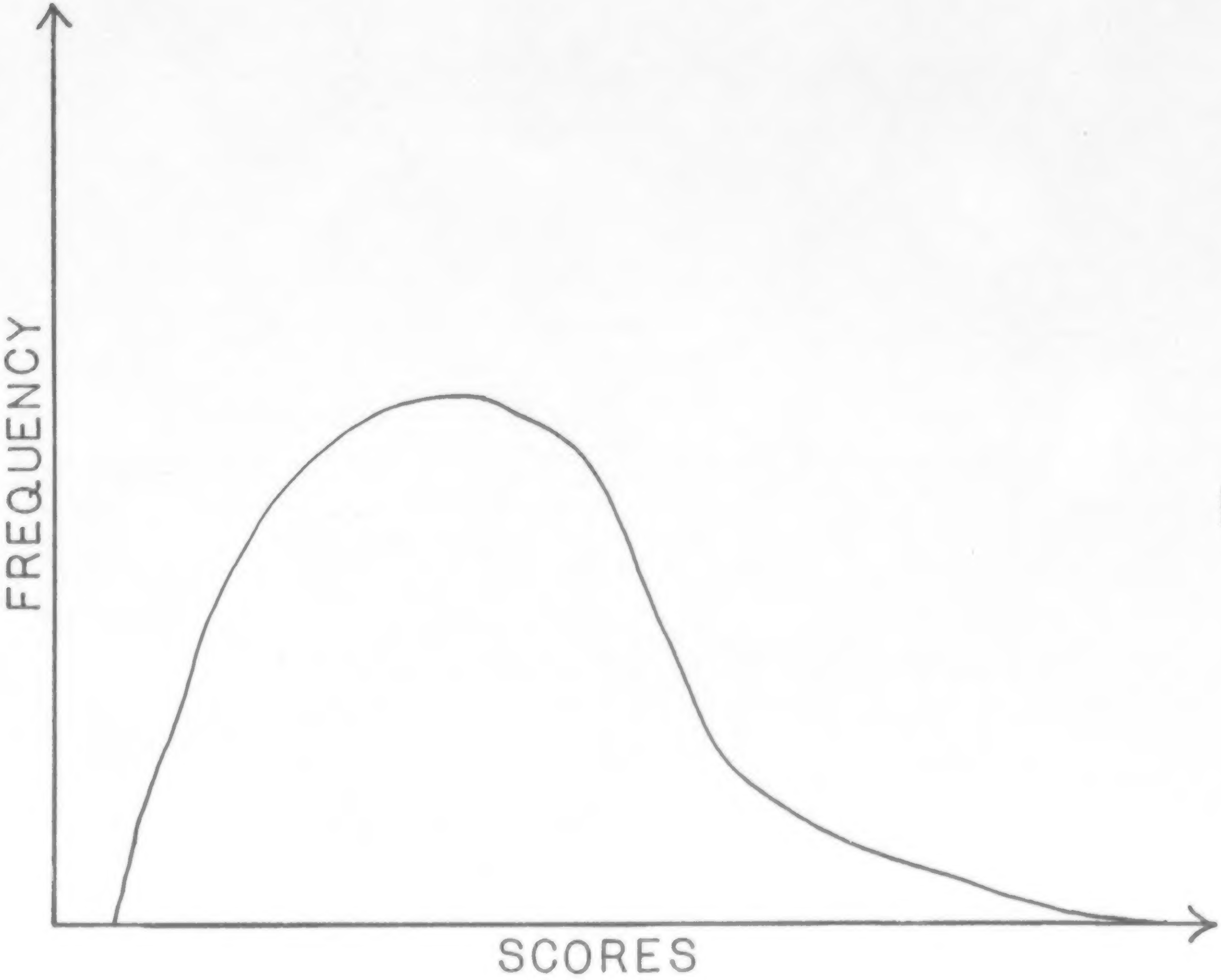
   b. If five less cars had been parked in the lot each day, what would the mean, median, and mode be? (For example, there would be 48 - 5 = 43 cars in the lot on Monday.)

6. Given: A = {⁻27, ⁻34, ⁻42, ⁻25, ⁻40, ⁻38}

   a. Find the mean, median, and mode for set A.

   b. Add +30 to each element of set A. Find the mean, median, and mode for this new set of numbers.

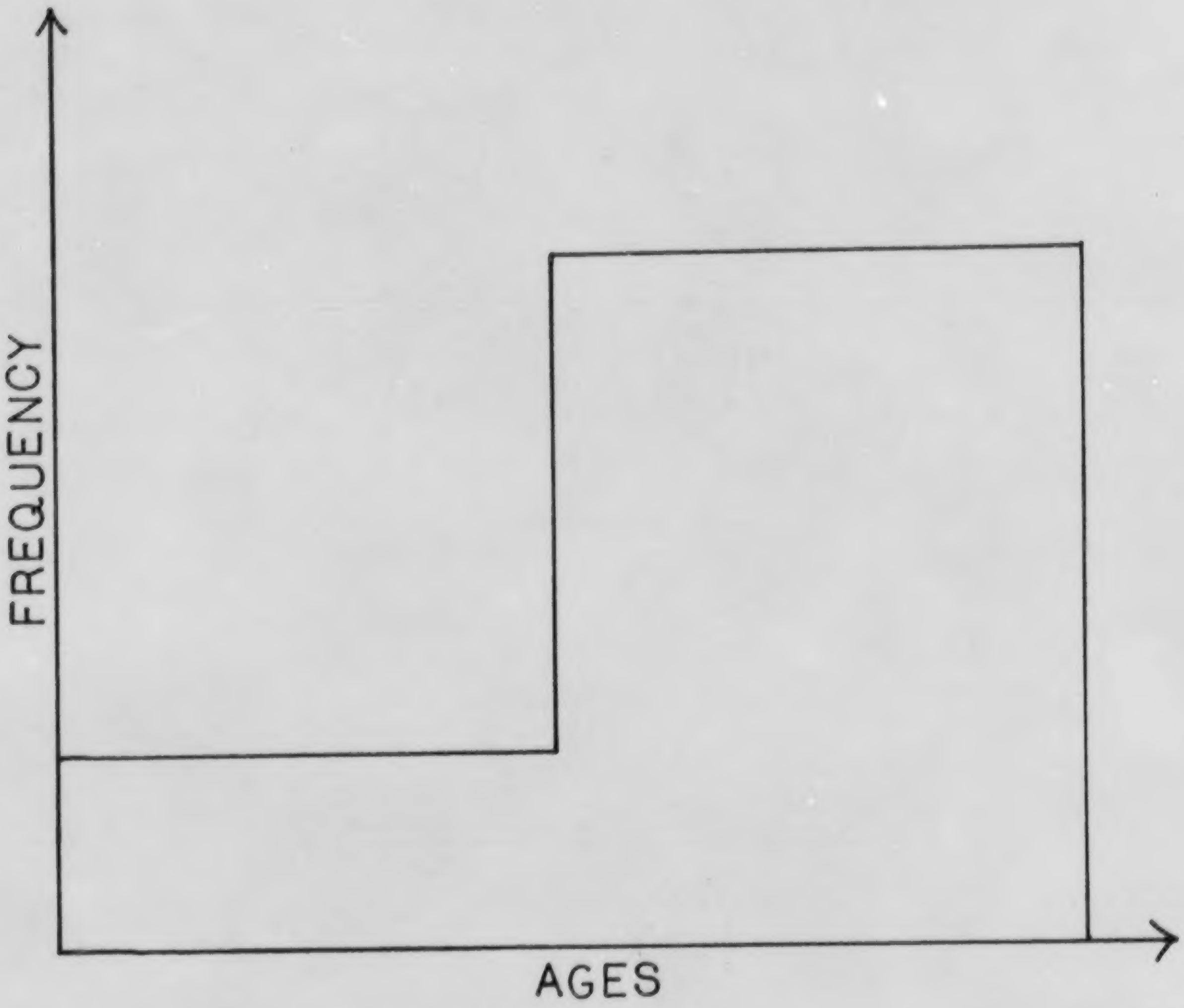
7. Analyze the results you obtained in problems 5 and 6. Compare the answers in 5a and 5b, and 6a and 6b. Can you generalize these results?



Chapters 3 & 4, Lesson 6
Transparency A

T88

Chapters 3 & 4, Lesson 6
Transparency B



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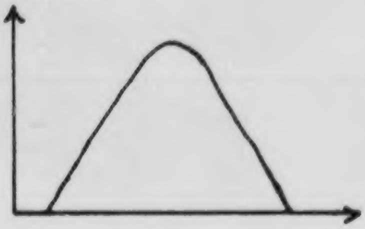
Chapters 3 & 4, Lesson 6 Name______________________

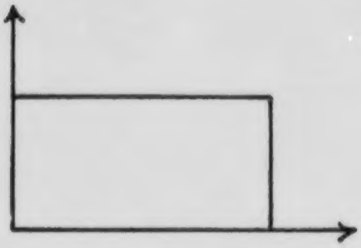
Worksheet 4 Date______________________

1. Estimate the mean, median, and mode for each distribution by sketching them on the graphs.

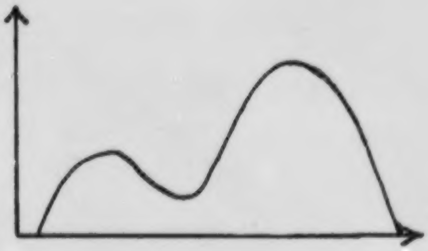
a.



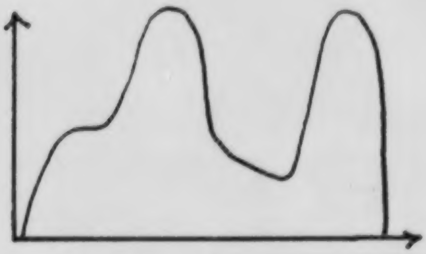
b.



c.



d.



2. If only one measure of central tendency could be used to describe each of the above data sets, which one would you choose and why?

a.

b.

c.

d.

3. Given: the mean, median, and mode of a distribution are all the same number. Make a sketch of what the distribution might look like.

4. If the mean of a distribution is 60 and the median is 65 what does this tell you about the shape of the distribution?

Chapters 3 & 4, Quiz 2

Name ______________________

Date ______________________

1. Which measure of central tendency is most sensitive to a few extreme scores? ______________

2. A survey was conducted on the usage of brands of soap. The results were as follows:

NUMBER OF BARS SOLD	
Brand A	161
Brand B	320
Brand C	240
Brand D	100

If you were stocking your store with soap to be sold, which brand would you stock? ______

Why? ______________________

____

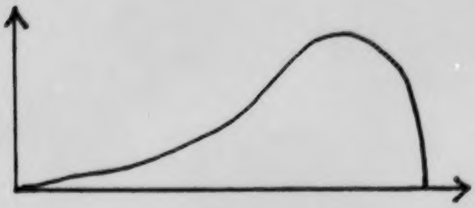
____

3. A = { 1, 5, 3, 2, 7, 9, 3, 8, 1, 5 } =

Mean = Median = Mode =

4. Ms. Chun gave a 10-point quiz yesterday. The mean score for her 15 students is 8. Unfortunately, Ms. Chun cannot find Winona's quiz. The other 14 scores were: 10, 10, 10, 9, 9, 8, 8, 8, 8, 7, 7, 7, 7, 4. What did Winona receive?

5. Estimate the mean, median, and mode for the distribution by sketching them on the graph.



6. A data set consists of 10 terms. Each term is a 1, or a 2, or a 3. What must the list be if the mean average is 1?

Chapters 3 & 4, Lesson 7
Transparency A

Given: $B = \{ 3, 3, 5, 6, 6, 6, 6, 7, 7, 8, 8, 8 \}$

$$\bar{x} = \frac{\Sigma x}{n} = \frac{3 + 3 + 5 + 6 + 6 + 6 + 6 + 7 + 7 + 8 + 8 + 8}{12}$$

$$= \frac{(3 \cdot 2) + (5 \cdot 1) + (6 \cdot 4) + (7 \cdot 2) + (8 \cdot 3)}{12}$$

$$= \frac{\Sigma(\text{each unique element} \cdot \text{frequency of that element})}{n}$$

$$= \frac{\Sigma x f_x}{n}$$

$$= \frac{\Sigma x f_x}{\Sigma f_x} \quad (n = \Sigma f_x)$$

So, $\bar{x} = \frac{\Sigma x f_x}{\Sigma f_x}$ is just a "shorthand" formula for grouped data.

Find the mean of the following distribution:

SCHOOL LUNCHES BOUGHT THIS WEEK BY STUDENTS IN IIA

NUMBER (X)	FREQUENCY (F)
0	8
1	6
2	5
3	3
4	3
5	5

Chapters 3 & 4, Lesson 8
Transparency

SALES MADE BY EMPLOYEES AT EASTERN ELECTRIC

NUMBER OF SALES (X)	FREQUENCY (F)		
0-4	2		
5-9	4		
10-14	7		
15-19	11		
20-24	5		

Chapters 3 & 4, Lesson 8
Worksheet 5

Name____________________________

Date____________________________

1. What is the formula for the mean of a distribution of grouped data?

2. Given:

Interval	Frequency (f_i)	Class Mark (x)	$x \cdot f_i$
2 - 6	1		
7 - 11	3		
12 - 16	7		
17 - 21	4		
22 - 26	3		
27 - 31	2		

a. Complete columns 3 and 4.
b. Find the approximate mean of the data.

c. What is the modal interval? __________

d. What is Σf_i? __________

e. Since there are 20 pieces of data in the distribution ($\Sigma f_i = 20$) the median score will be between the ________th and ________th piece of ranked data.

f. Therefore, the median interval is __________ .

g. In which interval is P_{50}? __________

3. Find the mean, modal interval, and median interval for the data below:

Interval	Frequency
4 - 10	2
11 - 17	3
18 - 24	5
25 - 31	6
32 - 38	9

4. Find the mean, modal interval, and median interval for the data below:

Interval	Frequency
0 - 2	87
3 - 5	61
6 - 8	30
9 - 11	42
12 - 14	24
15 - 17	12

105

Chapter 3 & 4, Lesson 9
Worksheet 6

Name______________________________

Date______________________________

1. Keola bought 20 shares of stock for $25, 50 shares of a second stock for $15, and 30 shares of a third stock for $20. What was his mean price for a share of stock?

2. Miss Hirata gave the same test to each of her Core Algebra classes. Her first class of 25 students had a mean score of 43. The second class of 20 students had a mean score of 38. What is the mean score for all of her students?

3. David Lani has three small credit loans outstanding: $100 at 12%, $50 at 18%, and another of $50 at 21%. What is the mean rate of interest he is paying for this money?

4. Mr. Vannett had a league bowling average of 130. Going into last night's games he had knocked down a total of 4290 pins. Last night he played 3 games and scored 110, 140, and 115. What is Mr. Vannett's new league average?

5. On a 50-item test, ten students got the following scores: 47, 47, 42, 44, 45, 49, 40, 44, 47, 45.

   a. Find the mean, median, and mode.

   b. Subtract the mean from each of the original scores. (Some answers will be positive, some will be negative.) What is the sum of these answers?

Chapters 3 & 4, Lesson 9
Worksheet 6 - Page 2

6. Give: M = {12, 21, 17, 19, 25, 10, 15, 17}

a. Find the mean, median, and mode of set M.

b. Subtract the mean from each element of set M. What is the sum of these answers?

7. Answers 5b and 6b should be equal. (If not, go back and check your work!) Why does this happen?

Chapters 3 & 4, Quiz 3

Name______________________________

Date______________________________

1. True or False : The mean may be defined as that point in a distribution about which the summed deviations equal zero.

Use the following table for

x	Frequency
3	1
4	2
5	2
6	1
7	3
8	2

2. Mode =

3. Median =

4. Mean =

5. Find the mean grade-point-average (GPA) for the students in MA134.

GPA	FREQUENCY
1.8 - 2.2	5
2.3 - 2.7	10
2.8 - 3.2	12
3.3 - 3.7	10
3.8 - 4.0	3

6. A set of data has 10 terms. Each term is a 1, or a 2, or a 5. List the terms so that their average is 4.

Chapters 3 & 4, Lesson 10

Worksheet 7

Name ______________________________

Date ______________________________

Simplify each of the following:

1. $|{}^{-}3| =$
2. $|527| =$
3. $|0| =$
4. $|5 + ({}^{-}3)| =$
5. $|5| + |{}^{-}3| =$
6. $|3| \cdot |{}^{-}2| =$
7. ${}^{-}3 \cdot |{}^{-}2| =$
8. $-|{}^{-}17 - 18| =$
9. $|36| + |{}^{-}36| =$
10. $|{}^{-}19 - ({}^{-}11)| =$

True or False.

11. $|{}^{-}7| + |7| = 0$
12. $|{}^{-}6 + ({}^{-}9)| = |{}^{-}6| + |{}^{-}9|$
13. $|{}^{-}3/2| = |1 + 1/2|$
14. $|3| + |{}^{-}3| = 2 \cdot |{}^{-}3|$

Find all possible values of x that make each statement true. The first one is done for you.

15. $|x| =$ $\{63, {}^{-}63\}$
16. $|x| = 2.3$
17. $|x| = 0$
18. $|x| = {}^{-}2$
19. $|x| + 1 = 4$
20. $|x - 3| = 1$

Chapters 3 & 4, Lesson 11
Transparency A

GEORGE WANTS TO FIND THE BEST (FASTEST) WAY TO GET TO SCHOOL.

HE TOOK EACH EXRESSWAY 7 TIMES AND RECORDED THE NUMBER OF MINUTES NEEDED TO DRIVE TO SCHOOL:

KALAKAUA EXPRESSWAY: 10, 20, 20, 20, 20, 20, 30

COOKE EXPRESSWAY: 10, 10, 10, 20, 30, 30, 30

Chapters 3 & 4, Lesson 11
Transparency B

KALAKAUA EXPRESSWAY

	Number of Minutes (x)	Mean (μ)	$x - \mu$
	10	20	$^{-}10$
	20	20	0
	20	20	0
	20	20	0
	20	20	0
	20	20	0
	30	20	$^{+}10$
TOTALS:	100		0

$N = 7$

$$\mu = \frac{\Sigma x}{n} = \frac{140}{7} = 20$$

$$\text{Average distance from mean} = \frac{\Sigma(x - \mu)}{n} = \frac{0}{5} = 0$$

Chapters 3 & 4, Lesson 11
Transparency B Overlay

$\lvert x - \mu \rvert$
10
0
0
0
0
0
10
20

$$\text{Average Deviation} = \frac{\Sigma\lvert x - \mu\rvert}{n} = \frac{20}{7} \approx 2.9$$

Chapters 3 & 4, Lesson 12 Name ____________________

Worksheet 8 Date ____________________

Given the elements in set x with a mean of 2. Simplify each of the following showing all work.

$$x = \{1, 2, 3, 3, 0, 1, 2, 2, 4\}$$

$$\mu = 2$$

1. $\Sigma x =$
2. $\Sigma x^2 =$
3. $(\Sigma x)^2 =$
4. $\Sigma(x - \mu) =$
5. $\Sigma(x - \mu)^2 =$
6. $\Sigma|x - \mu| =$
7. $\Sigma|x - \mu|^2 =$
8. $2 \cdot \Sigma x =$
9. $\Sigma x^2 - (\Sigma x)^2 =$
10. $\Sigma 4x =$

Given the elements of set y simplify each of the following showing all work. You will also need to refer to set x above.

$$y = \{5, 1, 8, -3, 0, -4, 2\}$$

11. $\Sigma y =$
12. $\Sigma y^2 =$
13. $(\Sigma y)^2 =$
14. $\Sigma|y| =$
15. $\Sigma{-2}\cdot|y| =$
16. $\Sigma y - \Sigma x =$
17. $\Sigma x \cdot \Sigma y =$
18. $\Sigma x^2 \cdot (\Sigma y)^2 =$
19. $\Sigma x + \Sigma|y| =$
20. $\frac{\Sigma x}{\Sigma y^2} =$

Chapters 3 & 4, Lesson 13
Overlay

$\|x - \mu\|$	$(x - \mu)^2$
10	
0	
0	
0	
0	
0	
10	
20	

Average deviation $= \frac{\Sigma|x-\mu|}{n} = \frac{20}{7} \approx 2.9$

Variance $= \frac{\Sigma(x-\mu)^2}{n} =$

Chapters 3 & 4, Quiz 4

Name ______________________________

Date ______________________________

1. $|5 - 8| =$

Given: $x = \{-2, 0, 3, 5\}$

2. $\Sigma x =$

3. $\Sigma x^2 =$

4. $(\Sigma x)^2 =$

5. Ten women registered with a downtown dating service. Their ages are 18, 27, 21, 15, 17, 22, 18, 19, 23, and 20. What is the range of their ages?

6. In a recent survey of people attending discos, the average age was $\overline{X} = 27$. The ten people questioned in the survey were:

   26, 29, 31, 24, 18, 30, 30, 29, 27, 26

   What is the average deviation of these ages?

7. What is the variance of the ages in problem 6?

Chapters 3 & 4, Lesson 14

Worksheet 9

Name________________________________

Date________________________________

The square root of a number is the value which, when multiplied by itself, equals that number. Every positive real number has two square roots.

> For example, the square roots of 81 are 9 and -9 because $9 \times 9 = 81$ and $-9 \times -9 = 81$.

The positive square root of a number is denoted by the symbol $\sqrt{\ }$ and the negative root by $-\sqrt{\ }$.

$$\sqrt{81} = 9 \qquad -\sqrt{81} = -9$$

1. $\sqrt{100}$

2. $-\sqrt{64}$

3. True or False.
   $\sqrt{9} + \sqrt{16} = \sqrt{25}$

4. $\sqrt{16} + \sqrt{16}$

5. $\sqrt{4} \cdot \sqrt{9}$

6. True or False.
   $2 < \sqrt{8} < 3$

Use the square root table on pages 454-462 to simplify the following.

7. $\sqrt{7}$

8. 2.87^2

9. $\sqrt{4.44}$

10. $-\sqrt{6.5}$

11. 7.58^2

12. $\sqrt{2}$

13. $\sqrt{3} \cdot \sqrt{3}$

14. $\dfrac{\sqrt{8}}{\sqrt{2}}$

The last column of the tables helps in finding the square roots of somewhat larger numbers.

> Since $73 = 10 \times 7.3$ we can say $\sqrt{73} = \sqrt{10 \times 7.3}$
> To get the decimal value find 7.3 and look in the last column under $\sqrt{10N}$. $\sqrt{73} = \sqrt{10 \times 7.3} \approx 8.54$

Simplify each of the following.

15. $\sqrt{85}$

16. $\sqrt{19}$

17. $\sqrt{20.2}$

18. $\sqrt{36}$

19. $\sqrt{27.4}$

20. $\sqrt{5.9}$

Chapters 3 & 4, Lesson 15
Overlay

$\lvert x-\mu \rvert$	$(x-\mu)^2$
10	100
0	0
0	0
0	0
0	0
0	0
10	100
20	200

Average deviation $= \frac{\Sigma\lvert x-\mu\rvert}{n} = \frac{20}{7} \approx 2.9$

Variance $= \sigma^2 = \frac{\Sigma(x-\mu)^2}{n} = \frac{200}{7} \approx 28.6$

Standard deviation $= \sigma = \sqrt{\text{Variance}}$

$= \sqrt{28.6}$

≈ 5.35

Chapters 3 & 4, Lesson 16
Transparency

Julie practiced the piano 5 days last week for 4 hours, 3 hours, 5 hours, 2 hours, and 3 hours.

Find the mean, variance, and standard deviation for the number of hours she practiced.

x	x^2
4	
3	
5	
2	
3	
$\Sigma x = 17$	$\Sigma x^2 =$

$$\text{Mean} = \frac{\Sigma x}{n} =$$

$$\text{Variance} = \sigma^2 = \frac{\Sigma x^2}{n} - \frac{(\Sigma x)^2}{n^2}$$

$$=$$

$$=$$

$$\text{Standard Deviation} = \sigma = \sqrt{\text{variance}}$$

$$= \sqrt{\qquad} \approx$$

Chapters 3 & 4, Quiz 5

Name ______________________________

Date ______________________________

1. The standard deviation for a recent exam was 6. The variance for the exam was __________.

2. $\sqrt{34.8}$ is between which two whole numbers? _______ and _______

3. Given the set $X = \{8, 4, 9, {}^{-}2, 6\}$

   a. Range =

   b. Mean = μ =

   c. Complete the table

x	$x - \mu$	$\lvert x - \mu \rvert$	$(x - \mu)^2$
8			
4			
9			
${}^{-}2$			
6			
		Σ =	Σ =

   d. Average Deviation =

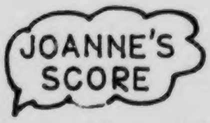
   e. Variance = σ^2 =

   f. Standard Deviation = σ =

4. Find the standard deviation for the set $Y = \{3,3,3,3\}$

Chapters 3 & 4, Lesson 17
Transparency A

FIRST PERIOD SCORES:

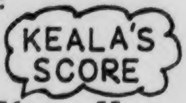


65	58	56	50	40	38	35	34	33	33
33	32	32	27	25	24	24	15	12	12

Percentile Rank of Joanne = 82.5

Mean = 33.9

SECOND PERIOD SCORES:



58	57	56	55	55	55	55	55	54	54
53	53	53	52	52	51	50	48	45	40

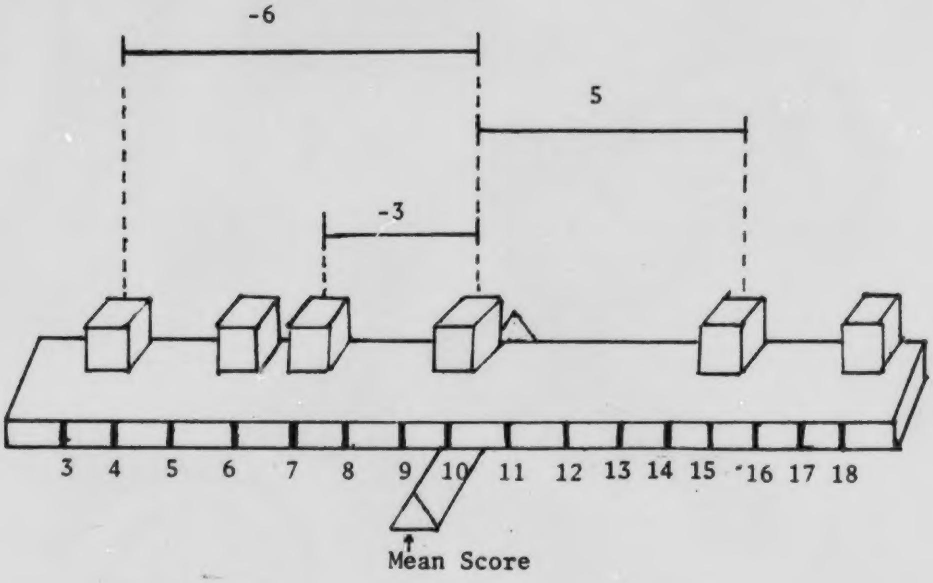
Percentile Rank of Keala = 82.5

Mean = 52.55

Chapters 3 & 4, Lesson 17
Transparency B

Given: A = {4, 6, 7, 10, 15, 18} $\mu = 10; \sigma = 5$

To find the distance and direction of any score from the mean, subtract the mean from that score $(x - \mu)$.


-6
5
-3
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Mean Score

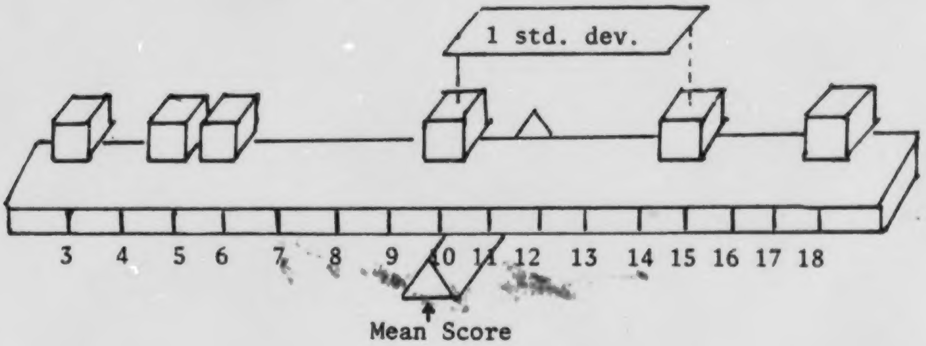
-6 indicates that the score 4 is 6 units away from the mean in a negative direction.

5 indicates that the score 15 is 5 units away from the mean in a positive direction.

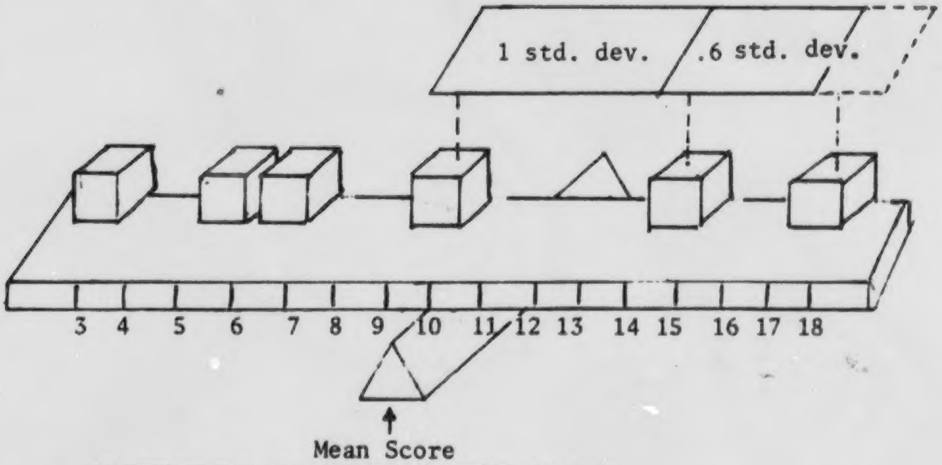
What does -3 indicate?

Chapters 3 & 4, Lesson 17
Transparency C

A = {4, 6, 7, 10, 15, 18} $\mu = 10, \sigma = 5$


1 std. dev.
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Mean Score

The distance between the score 15 and the mean is equivalent to 1 measure of the standard deviation. Therefore, 15 has a "z-score" of +1.


1 std. dev.
.6 std. dev.
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Mean Score

The distance between 18 and the mean is +8. This is equivalent to 1.6 standard deviations. Therefore, 18 has a z-score of +1.6.

Chapters 3 & 4, Lesson 17
Transparency D

	Joanne	Keala
Individual Score	56	56
Percentile Rank	82.5	82.5
Class Mean	33.9	52.55
Standard Deviation	14.14	4.13
z - score *	2.2	1.32

$$* \; z_{\text{Joanne}} = \frac{x - \mu}{\sigma} = \frac{56 - 33.9}{14.14} \approx 2.2$$

$$z_{\text{Keala}} = \frac{x - \mu}{\sigma} = \frac{56 - 52.55}{4.13} \approx 1.32$$

Who has the higher z-score? ______________________________

This means that ______________________ did better on the test with respect to his/her classmates than ______________________ did.

Chapter 3 & 4, Lesson 17 Name__________________________

Worksheet 10 Date__________________________

1. A ________________ indicates how many standard deviations above or below the mean an individual score lies.

2. In a distribution $\mu = 50$ and $\sigma = 8$.

   a. What value has a z-score of $^{+}1$? (In other words, what score is equal to the mean plus one standard deviation?) __________________

   b. A z-score of $^{-}1$ indicates that a score is one standard deviation below the mean. So if $z = {}^{-}1$, $x = 50 -$ _____ = _____.

   c. If $z = 2.3$ the individual score is equal to the mean plus _____ times the standard deviation. Since $2.3 \times 8 =$ _____ this means the score $50 +$ _____ or _____.

   d. If $z = 0$, $x =$ _____.

   e. If $z = {}^{-}1.5$, $x =$ _____.

3. Different aptitude tests must be taken by all job applicants at Hawaiian Utility Co. Brian received 37 out of 100 on the computation test, 140 out of 200 on the manual dexterity test and 47 out of 60 on the social interaction test. Is Brian well qualified for a position at the company? ______

   ____

   ____

4. If Brian's scores (see #3) are converted to z-scores they are

   $z = {}^{-}1.5$ on the computation test
   $z = {}^{+}0.4$ on the manual dexterity test
   $z = {}^{+}1.2$ on the social interaction test.

   a. This means that relative to other candidates Brian scored above the mean on _____ test(s) and below the mean on _____.

   b. Would Brian be better suited for a job as a bookkeeper, on an assembly line or in the customer service department? ____________
   Why? ____

   ____

5. True or False: In any distribution if $z = 0$, then $x = \mu$.
   Why or why not? ____

   ____

6. Can a score with a percentile rank of 60 have a negative z-score? ________
   Why or why not? ____

   ____

Chapter 3 & 4, Lesson 17
Worksheet 10 - Page 2

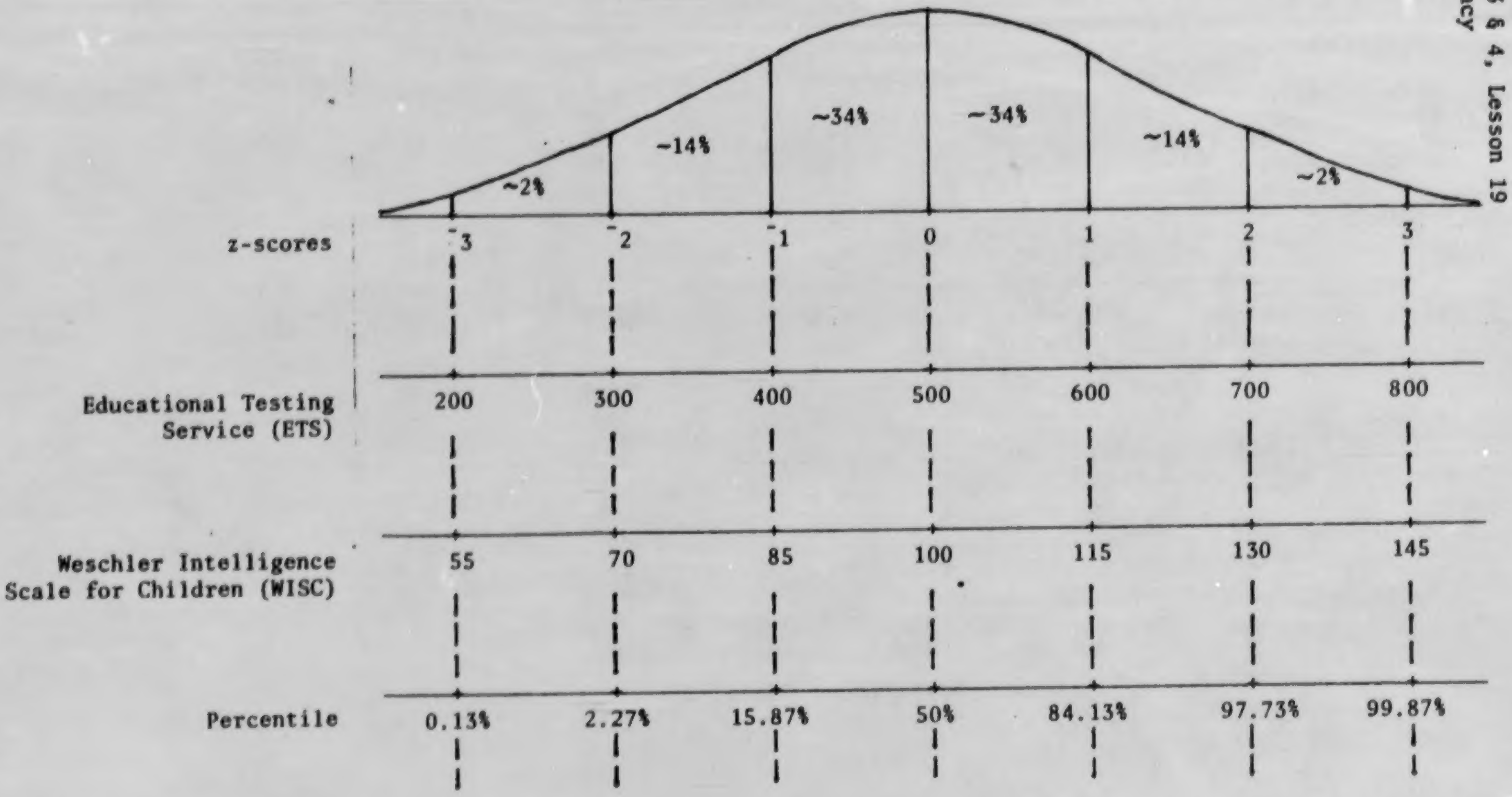
7. A private school in Kaneohe gave two forms of an admissions test. Sue scored 500 on Form A where $\mu = 400$ and $\sigma = 100$. On Form B where $\mu = 400$ and $\sigma = 50$ Carol scored 500. If the school can accept only one of the students which one should they select? ______________ Why? ______________

    ____

8. If a score of 27 has a z-score of 1 and a score of 30 has a z-score of 2, what does this tell you about the standard deviation of the distribution?

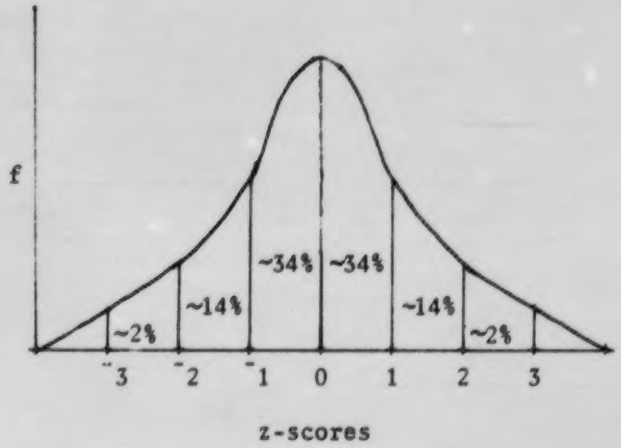
Chapters 3 & 4, Lesson 19
Transparency

T117



Chapters 3 & 4, Lesson 19 Name __________________________

Worksheet 11 Date __________________________



A normal distribution like the one above might result if the heights of every living American man were measured. Suppose the mean height of these men is 68" and the standard deviation is 2".

1. What is the z-score for a height of 66"?

2. Someone whose height is 66" has a z-score of __________. Therefore, that person is taller than approximately __________% of other American males.

3. How tall is someone whose height has a z-score of $^{+}1.5$?

4. Someone with a z-score of $^{+}1$ is taller than __________% of the other men.

   Someone with a z-score of $^{+}2$ is taller than __________% of the other men.

   Therefore, someone with a z-score of 1.5 is taller than _____ - _____%

   of the other men.

5. What percent of men are taller than 5'4"?

6. What percent of men are between 64" and 70"?

Chapters 3 & 4, Lesson 19
Worksheet 11 - Page 2

7. Sketch a normal distribution in which $\mu = 5.0$ ounces and $\sigma = 0.5$ ounces. Be sure to label the horizontal axis.

8. Suppose a new cafeteria opens and their policy is to serve 5 oz. of meat in every sandwich. If the distribution is normal and $\sigma = 0.5$ oz. (see #7) what are the chances that someone will be served less than 4 oz. of meat?

9. Alex bought a candy bar that weighed approximately 2.5 ounces according to the wrapper. If the weight of these candy bars is normally distributed with $\mu = 2.5$ oz. and $\sigma = .15$ oz. what is his chance of getting a candy bar weighing more than 2.65 oz.?

Chapters 3 & 4, Quiz 6

Name ______________________________

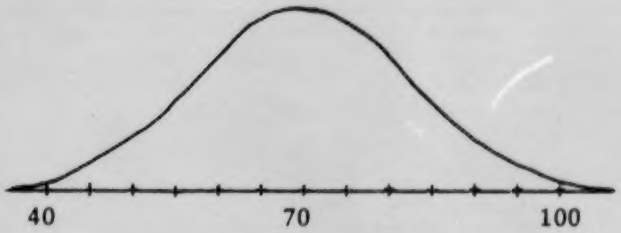
Date ______________________________

1. A z-score indicates how many ______________ a value is above or below the mean.

2. A normal distribution is symmetric about the value z = __________.

3. In this normal distribution, which of the following is the best approximation for σ?

a) 5 b) 10 c) 15 d) 30



4. In a distribution with $\mu = 24$ and $\sigma = 3$ find the z-score for $x = 19$.

5. Following are the results of a Women's 10 km. race:

time (in min.)	z-score	percentile rank
50	¯2	10
56	¯1	40
62	0	62
68	1	75
74	2	89

a. What was the mean time? __________

b. What percent of women took between 50 and 62 min.? __________%

c. Carol's z-score is 1.8. What was her time?

6. When weighed on a scale, one-pound boxes of Herman's chocolate are known to average 1.04 pounds. The weights have a standard deviation of .02 pounds and they have a normal distribution. What percent of customers will be "cheated?" That is, what percent of the boxes will weigh less than one pound?

Chapters 3 & 4, Lesson 20
Transparency

C = {27, 35, 19, 23, 34, 18}

x	x^2
27	729
35	1225
19	361
23	529
34	1156
18	324
$\Sigma x = 156$	$\Sigma x^2 = 4324$

$$\mu_x = \frac{\Sigma x}{n} = \frac{156}{6} = 26$$

$$\sigma_x^2 = \frac{\Sigma x^2}{n} - \frac{(\Sigma x)^2}{n^2}$$

$$= \frac{4324}{6} - \frac{(156)^2}{6^2}$$

$$= 720.\overline{6} - 676 = 44.\overline{6}$$

$$\sigma_x = \sqrt{44.\overline{6}} = \sqrt{10 \times 4.4\overline{6}} \approx 6.69$$

$y = x - 25$	$y^2 = (x - 25)^2$
2	4
10	100
$^{-}6$	36
$^{-}2$	4
9	81
$^{-}7$	49
$\Sigma y = 6$	$\Sigma y^2 = 274$

$$\mu_y = \frac{\Sigma y}{n} = \frac{6}{6} = 1$$

$$\sigma_y^2 = \frac{\Sigma y^2}{n} = \frac{(\Sigma y)^2}{n^2}$$

$$=$$

$$=$$

$$\sigma_y = \sqrt{\qquad\qquad} =$$

COMPARE:

a. μ_x and μ_y b. σ_x^2 and σ_y^2 c. σ_x and σ_y

Chapters 3 & 4, Lesson 21

Worksheet 12

Review Project

88	95	92	80	77	89	77	83	79	92
76	84	86	81	79	83	88	74	85	94
64	72	75	87	82	76	82	87	78	88
94	83	78	83	84	81	74	94	81	84
80	97	84	88	79	91	85	80	77	85
92	83	65	62	60	69	97	85	64	84
80	86	88	77	53	82	91	84	83	79
72	91	73	90	75	83	58	72	85	103
96	64	85	85	81	86	67	83	81	85
83	77	82	78	91	74	79	87	92	76
88	87	80	87	92	83	87	77	75	70
111	80	83	84	74	82	80	85	80	88
98	77	93	79	89	84	89	76	86	85
74	93	60	83	77	84	68	71	79	81
81	60	72	86	79	76	86	90	85	87
87	74	82	84	89	86	102	88	73	74
81	88	85	91	81	80	78	80	84	90
58	76	76	88	68	82	85	81	82	86
67	83	90	75	78	86	80	76	83	82
79	77	86	84	84	61	87	83	73	84

The above data represents the pulse rate of 200 walk-in patients at the Hawaii Clinic.

This project must be turned in (neatness counts). It should include a Title Page and a Table of Contents. This paper should be attached to the final report.

1. Make a grouped frequency distribution with columns: interval, class mark (X), tally, frequency (F), relative frequency, cumulative frequency (CF), and cumulative % (C%). The first interval should be 50-54.

2. Make a histogram, frequency polygon, ogive, and circle graph.

3. Make a second frequency distribution by coding the data. Columns in this distribution should be X, Y, F, F_X, and F_{X^2} where X is the class mark and F is the frequency (both from the first distribution). Y is the coded value found by subtracting a constant from each X.

4. Evaluate the measures of central tendency: mean, median, and mode. (The table made in #3 should be of help here!) Mark each of these values on the frequency polygon.

Chapters 3 & 4, Lesson 21
Worksheet 12 - Page 2

5. Evaluate the measures of dispersion: range, variance, standard deviation.

6. Evaluate and label the following values of Z on the frequency polygon: $^{-}3$, $^{-}2$, $^{-}1$, 0, 1, 2, 3

7. What percent of the distribution is between 74.5 and 89.5?

8. Use the ogive to estimate P_{16}, P_{84}, P_{97}, PR_{82}, PR_{70}.

9. Compare your estimate of P_{84} with x when $z = 1$. Is there any relationship?

10. If the work was done in a group, state how the work was divided up (who did what).

Chapters 3 & 4 Name ______________________________

Chapter Test Date ______________________________

Part I. Match the terms with their formulas by placing the letter of the correct formula in the space provided.

a. $\frac{\Sigma(x - \mu)}{n}$

b. $\sqrt{\text{variance}}$

c. $\frac{\Sigma|x - \mu|}{n}$

d. $\mu + \sigma \cdot x$

e. $\frac{\Sigma x}{n}$

f. $\mu + z \cdot \sigma$

g. $\frac{\Sigma x f_x}{\Sigma f_x}$

h. $\frac{(\Sigma x)^2}{n} - \frac{\Sigma x^2}{n^2}$

i. $\frac{\Sigma(x - \mu)^2}{n}$

j. $\frac{\Sigma x^2}{n} - \frac{(\Sigma x)^2}{n^2}$

k. $\frac{x - \mu}{\sigma}$

l. $\sqrt{\text{standard deviation}}$

1. _______ Mean
2. _______ z-score
3. _______ Average Deviation
4. _______ Standard Deviation
5. _______ Mean for Grouped Data
6. _______ Original Score X
7. _______ Variance
8. _______ Variance (Computational Form)

Chapters 3 & 4 Name ______________________

Chapter Test Date ______________________

Part II.

True or False:

1. _______ The mean is a measure of variation.

2. _______ Coding does not affect calculation of the variance of a distribution.

3. _______ Although two distributions may have the same variance, they may have different standard deviations.

4. _______ $\Sigma(x - \mu) = 0$ always.

5. _______ In a normal distribution, approximately 68% of the area is found between $^-1$ and $^+1$ standard deviation ($\pm\sigma$).

6. _______ If $x = \{^-3, 0, 5\}$ then $\Sigma x^2 = 4$.

7. _______ The median is more strongly affected by an extreme value than the mean is.

8. _______ Computing $\bar{x}$ for grouped data gives exactly the same answer as adding all individual values and dividing by n.

Complete each of the following:

9. $^-|3 - 5| =$ __________

10. $|^-6| + |2| =$ __________

11. $\sqrt{73}$ is between which two whole numbers? _______ and _______

12-14. The Weldon's last six phone bills were for \$29.34, \$39.78, \$18.51, \$52.19, \$45.53, and \$23.88.

a) Mean = __________

b) Range = __________

c) Median = __________

15. You earn a score of 80 on a test. In which class would you rather be? One with

    a. $\mu = 70$, $\sigma = 10$

    b. $\mu = 75$, $\sigma = 5$

    c. $\mu = 60$, $\sigma = 15$

    d. $\mu = 80$, $\sigma = 2$

    e. $\mu = 76$, $\sigma = 2$

16. If a score of 20 has a percentile rank = 65 which of the following is true?

    a. 20% of a comparison group scored below 65.

    b. 20% of a comparison group scored above 65.

    c. 65% of a comparison group scored above 20.

    d. 65% of a comparison group scored below 20.

    e. none of the above

17. The following measurement(s) is/are always a unique number:

    a. mean
    c. mode
    e. mean and mode

    b. median
    d. mean and median

18. Fred earned a score of 80 on his statistics test, placing him at the 88th percentile. If ten points were added to each score on the distribution, his new score of 90 would be at the:

    a. 90th percentile
    c. 88th percentile
    e. impossible to answer without further information

    b. 98th percentile
    d. none of the above

19. If a survey shows that American tourists want to visit Tahiti more than any other South Pacific Island we can say that Tahiti is their

    a) mean choice.
    c) median choice.

    b) modal choice.
    d) all of the above.

20. The following sets of scores were obtained on a test X: 4, 5, 8, 9, 11, 13, 16, 24, 24, 24, and 26. The teacher computed various measures of central tendency and measures of variation before noticing an error had been made. One of the 24's should have been a 17. Which of the following computations will have to be redone?

a. median
b. mode
c. range
d. standard deviation

21. If a constant is added to each element of a set of scores, the standard deviation, σ, would

a. remain the same.
b. increase by the amount of the constant.
c. decrease by the amount of the constant.
d. increase by the square of the constant.

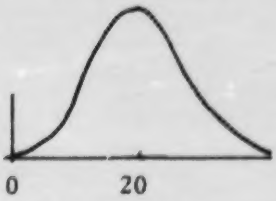
22-23. The following scores were received on Miss Chun's geometry quiz: 6, 4, 2, 10, 9, 9, 8, 6, 10, 9, 6, and 8.

a) What is the percentile rank of a score of 9?

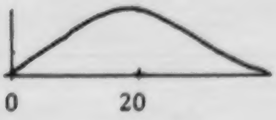
b) What % of scores have a value of 6?

24. Which distribution below has a smaller standard deviation?

a)



b)



Explain: ______________________________

____

A = {317, 158, 327, 249, 406}
B = {417, 258, 427, 349, 506} > use in #25 and 26

25. The mean of set A = 291.4. Therefore, the mean of set B = _________.

26. The variance of set B = 6929.84. Therefore, the variance of set A = _________.

27. John belongs to an age group for which the mean weight is 145 lbs. with a standard deviation of 10 lbs. Mary belongs to an age group for which the mean weight is 118 lbs. with a standard deviation of 4 lbs. If Mary weighs 124 lbs. and John weighs 157 lbs. which of the two is more seriously overweight compared to the appropriate age group?

28. The 20 students in Miss Hirata's first period class had a mean average of 83 on their test. Her second period class of 25 students had a mean average of 75 on the same test. What is the mean average for both classes combined?

FINISHERS IN 10K RACE

Time in minutes	Number
30-38	12
39-47	35
48-56	27
57-65	15
66-74	10
75-83	7
	106

29. In the table at the left the modal class is ______________________.

30. In the table at the left the median is in the interval ______________.

31. Complete the following table:

x	x^2	$(x - \mu)$	$\lvert x - \mu \rvert$	$(x - \mu)^2$
6				
9				
10				
12				
13				
$\Sigma = 50$				

Calculate the following for the data in problem 31.

32. Average Deviation =

33. Variance =

34. Standard Deviation =

Chapter 9, Lesson 1

Worksheet 1

Name ______________________________

Date ______________________________

1. For each of the following indicate what type of correlation you would expect: positive, negative, or zero.
    a. A parent's IQ and a child's IQ.
    b. The price of gas and the number of economy cars sold.
    c. The interest rates on mortgages and the number of new home loans.
    d. Speed of travel and travel time.
    e. The number of students at U.H. and the number of pets on Maui.
    f. Amount of homework done and score on test.
    g. SAT scores and success in college.
    h. Outside temperature and gallons of water used in city of Honolulu.
    i. The value of monthly loan payments and the number of months necessary to pay off loan.

2. Suppose daughters are always 10% shorter than their fathers. Is there a positive, negative, or zero correlation of their heights?

3. There is a positive correlation between blood pressure and income. How can this be explained. ______________________________

____

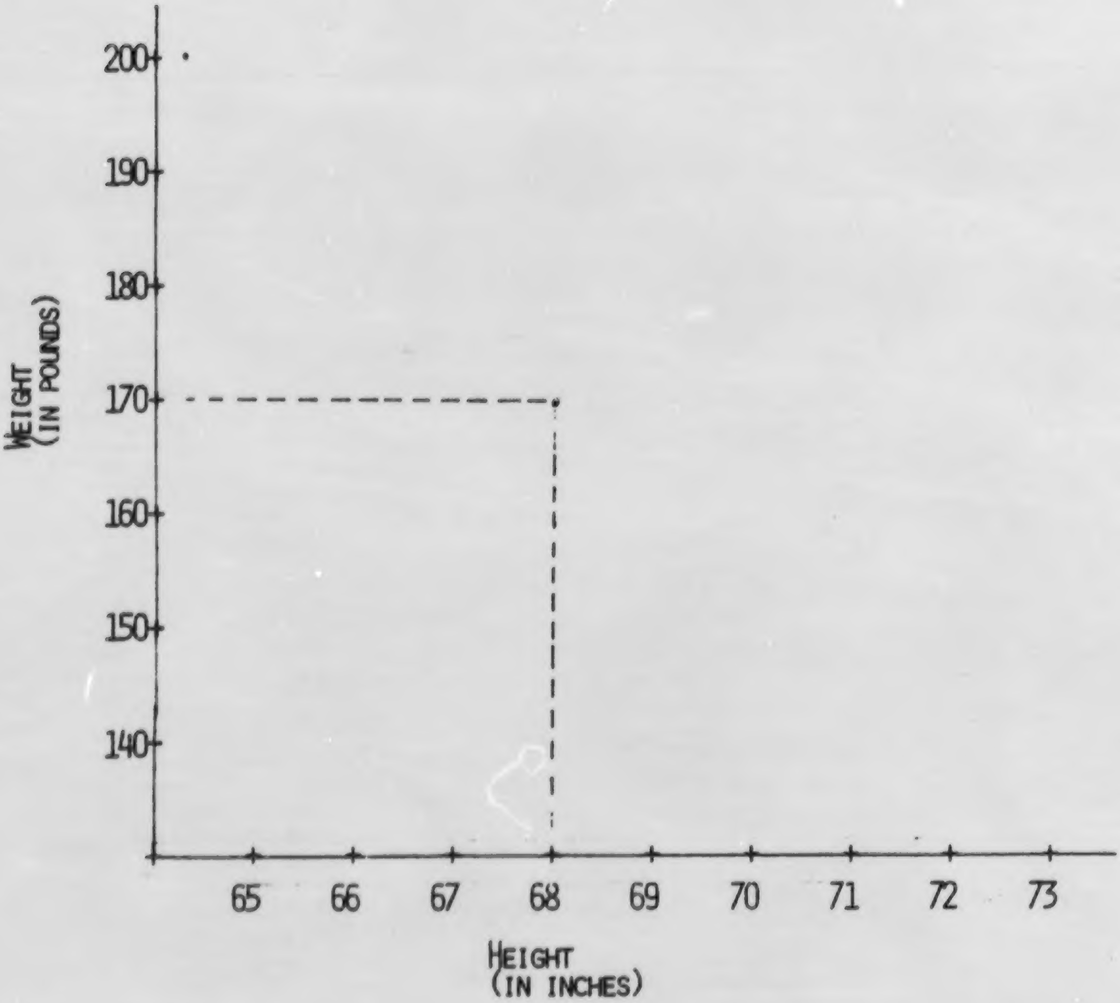
Is there a causal connection? That is, is there a cause-and-effect relationship? Does high blood pressure result in high income? Does high income result in high blood pressure? Explain. ______________________________

____

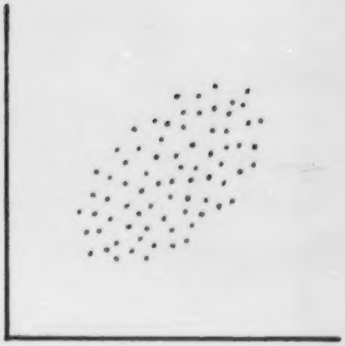
____

HEIGHT AND WEIGHT FOR 10 ADULT MALES

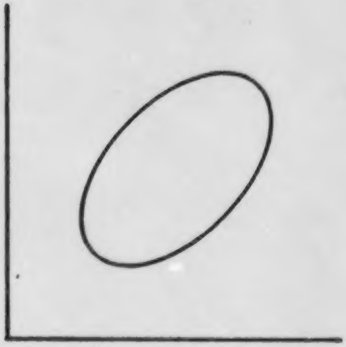
HEIGHT (IN INCHES)	68	66	71	69	69	68	65	72	67	73
WEIGHT (IN POUNDS)	170	161	190	172	155	180	143	200	158	195



Chapter 9, Lesson 3
Transparency A

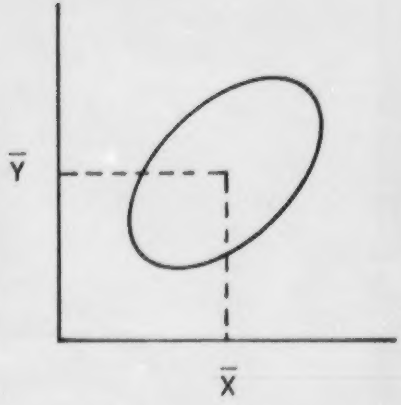


SCATTER DIAGRAM

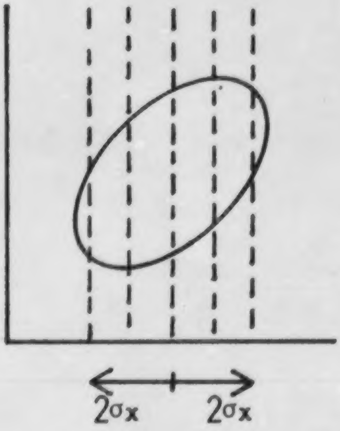


ROUGH SKETCH OF
SCATTER DIAGRAM

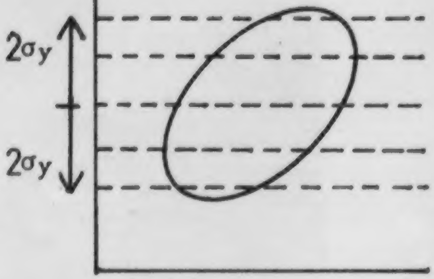
SUMMARIZING A SCATTER DIAGRAM:



CENTER OF DISTRIBUTION


$2\sigma_x$
$2\sigma_x$

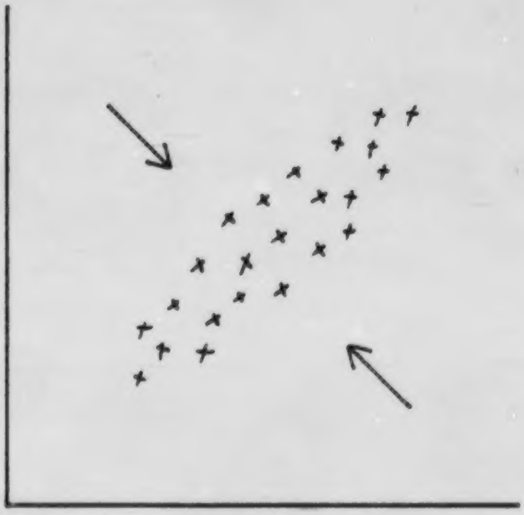
STANDARD DEVIATION OF X'S


$2\sigma_y$
$2\sigma_y$

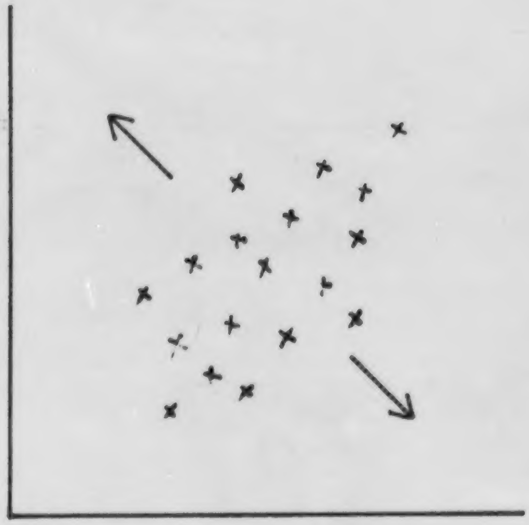
STANDARD DEVIATION OF Y'S

Chapter 9, Lesson 3
Transparency B

THESE SCATTER DIAGRAMS HAVE THE SAME RANGES, CENTERS, AND STANDARD DEVIATIONS.

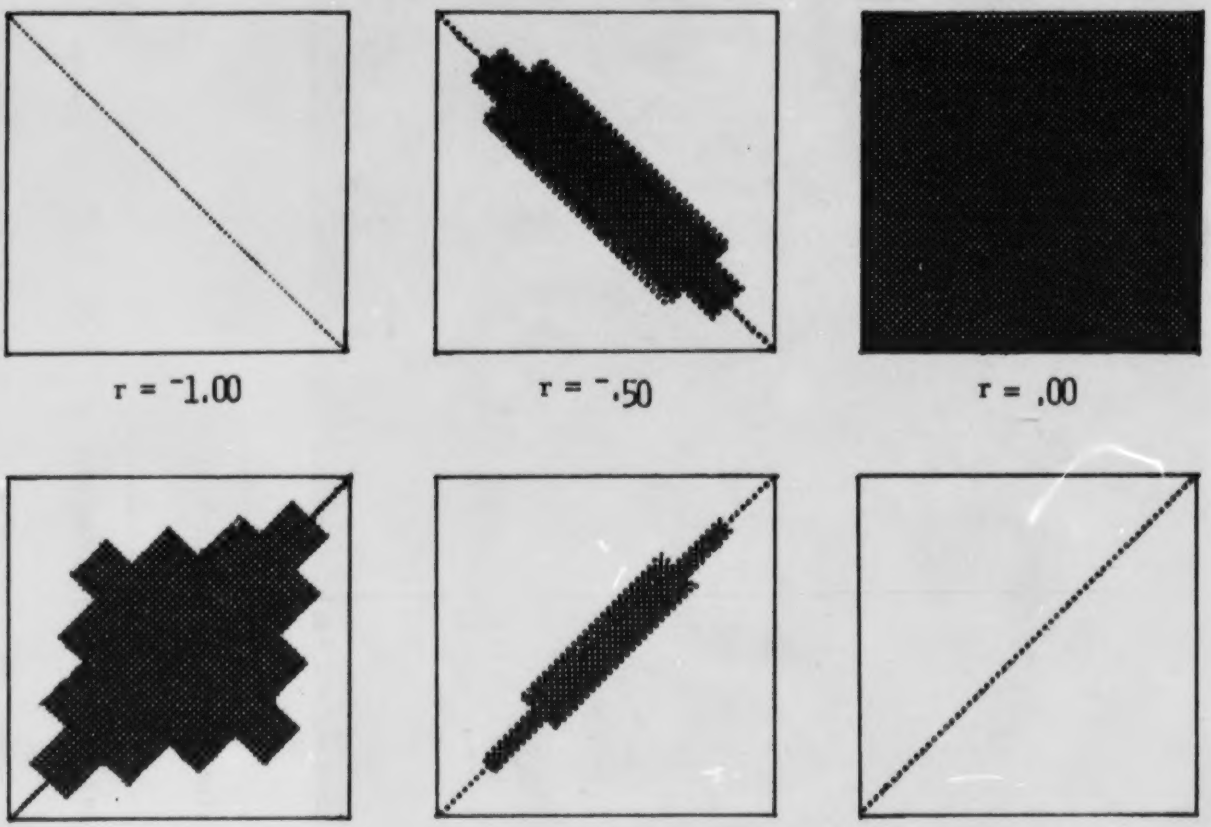


(a)



(b)

Chapter 9, Lesson 3
Transparency C



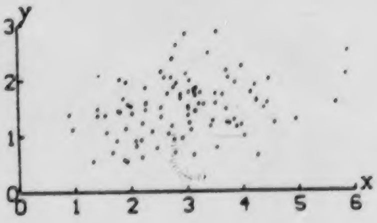
$r = {}^{-}1.00$ $r = {}^{-}.50$ $r = .00$

$r = {}^{+}.30$ $r = {}^{+}.85$ $r = {}^{+}1.00$

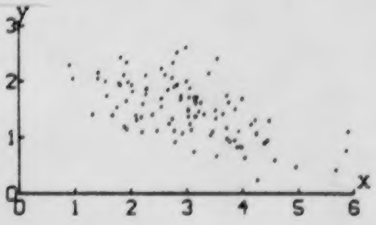
HYPOTHETICAL SCATTER DIAGRAMS AND THEIR CORRELATION COEFFICIENT

Chapter 9, Lesson 3 Name ____________________

Worksheet 2 Date ____________________



(a)



(b)

For each scatter diagram above

1. Guess whether the average of x is closest to 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, or 4.0

   (a) __________ (b) __________

2. Guess whether the average of y is closest to 0.5, 1.0, 1.5, 2.0, 2.5, or 3.0

   (a) __________ (b) __________

3. Guess whether the standard deviation of x is closest to 0.25, 0.5, 1.0, 1.5, or 2.0

   (a) __________ (b) __________

4. Guess whether the standard deviation of y is closest to 0.25, 0.5, 1.0, 1.5, or 2.0

   (a) __________ (b) __________

5. Is the correlation positive, negative, or 0?

   (a) __________ (b) __________

6. For which scatter diagram is the correlation closest to 0? __________

For each of the following guesstimate the value of the correlation coefficient.

7. SAT scores and college grade point average (GPA)

8. the temparature in Anchorage, Alaska and the temperature in Sydney, Australia

Chapter 9, Lesson 3
Worksheet 2 - Page 2

9. a parent's IQ and a child's IQ

10. mortgage rates and the number of houses bought

11. the number of students at Baldwin High School and the number of pets on Lanai

Given: $(x,y) = \{(4,2), (3,3), (2,0), (4,3), (1,2), (5,3)\}$

12. Complete the following table:

x	y	x^2	y^2	xy
4	2			
3	3			
2				
4				
1				
5	3			
$\Sigma=$	$\Sigma=$	$\Sigma=$	$\Sigma=$	$\Sigma=$

13. n = number of paired observations = __________

14. $n(\Sigma xy) =$ __________

15. $(\Sigma x) \cdot (\Sigma y) =$ __________

16. $n(\Sigma x)^2 =$ __________

17. $n(\Sigma x)^2 - (\Sigma x)^2 =$ __________

18. $n(\Sigma y)^2 =$ __________

19. $n(\Sigma y)^2 - (\Sigma y)^2 =$ __________

Chapter 9, Lesson 4
Transparency A

COEFFICIENT OF LINEAR CORRELATION

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{n(\Sigma x^2) - (\Sigma x)^2}\ \sqrt{n(\Sigma y^2) \quad (\Sigma y)^2}}$$

Chapter 9, Lesson 4
Transparency B

Find the coefficient of linear correlation for:

(4,2) (3,3) (2,0) (4,3) (1,2) (5,3)

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{n(\Sigma x^2) - (\Sigma x)^2}\sqrt{n(\Sigma y^2) - (\Sigma y)^2}}$$

From Worksheet 2 we know:

$n =$ ______ $\Sigma xy =$ ______ $\Sigma x =$ ______ $\Sigma y =$ ______

$\Sigma x^2 =$ ________ $\Sigma y^2 =$ ________

So...

$$r = \frac{6(\quad) - (\quad)(\quad)}{\sqrt{\_\_\_\_(426) - (\quad)^2} \bullet \sqrt{\_\_\_\_(\quad) - (13)^2}}$$

$r =$ ____

$r =$

Find the coefficient of linear correlation for a set of paired observations in which:

$\Sigma x = 15$ $\Sigma x^2 = 43$ $\Sigma xy = 107$

$\Sigma y = 52$ $\Sigma y^2 = 398$ $n = 7$

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{n(\Sigma x^2) - (\Sigma x)^2}\ \sqrt{n(\Sigma y^2) - (\Sigma y)^2}}$$

$r =$

149

Chapter 9, Lesson 4 Name ______________________________

Worksheet 3 Date ______________________________

Find the coefficient of linear correlation for a set of paired observations in which:

1. $n = 5$ $\Sigma x = 0$ $\Sigma y = 5$ $\Sigma x^2 = 10$ $\Sigma y^2 = 11$ $\Sigma xy = 6$

2. $n = 6$ $\Sigma x = 28$ $\Sigma y = 6$ $\Sigma x^2 = 232$ $\Sigma y^2 = 46$ $\Sigma xy = 66$

3. $n = 10$ $\Sigma x = 50$ $\Sigma y = 22$ $\Sigma x^2 = 340$ $\Sigma y^2 = 63$ $\Sigma xy = 84$

4. $n = 6$ $\Sigma x = 44$ $\Sigma y = 24$ $\Sigma x^2 = 366$ $\Sigma y^2 = 136$ $\Sigma xy = 213$

5. $n = 7$ $\Sigma y = 42$ $\Sigma x = 0$ $\Sigma xy = 56$ $\Sigma x^2 = 28$ $\Sigma y^2 = 368$

6. Complete the table below and compute the correlation coefficient for the following set of paired observations:

(0,1) (1,0) (2,4) (3,0) (6,6) (7,3) (21,7) (42,20) (48,17) (75,24)

x	y	xy	x^2	y^2
$\Sigma x=$	$\Sigma y=$	$\Sigma xy=$	$\Sigma x^2=$	$\Sigma y^2=$

Chapter 9, Quiz 1

Name ______________________________

Date ______________________________

1. The correlation between the number of uneaten homemade cookies and the amount of time since the cookies were baked is:

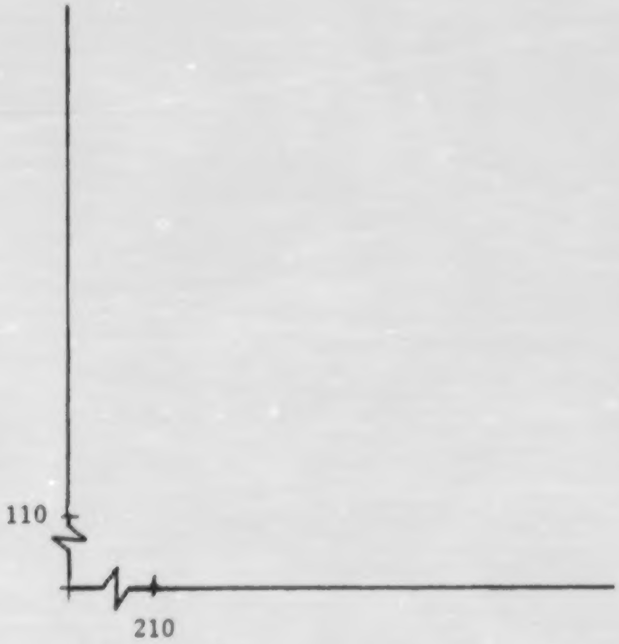
   a) positive b) negative c) zero

2. Which of the following relationships has the strongest correlation? One with

   a) $r = {}^{-}.6$ b) $r = {}^{+}.3$ c) $r = 0$ d) $r = {}^{-}.1$

3. Make a scatter diagram below for x = # of public schools and y = # of private schools:

	SCHOOLS IN HAWAII	
	# public schools	# private schools
1966	210	112
1967	215	114
1968	217	116
1969	216	123
1970	216	117
1971	219	112
1972	222	119
1973	225	120
1974	225	120
1975	225	119
1976	227	126



Estimate the value of r from the diagram: __________

4. Given: $n = 9$ $\Sigma x = 30$ $\Sigma y = 15$ $\Sigma xy = 70$ $\Sigma x^2 = 128$ $\Sigma y^2 = 43$

Evaluate r: $$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{n\Sigma x^2 - (\Sigma x)^2}\sqrt{n\Sigma y^2 - (\Sigma y)^2}}$$

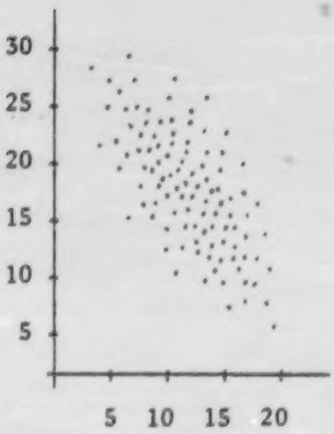
5. Find the correlation coefficient for the following data. (Hint: First organize the data in a table and find the appropriate sums.)

WATER STOPS MADE BY JOGGERS

# MILES RUN	2	7	3	8	4	1	1
# WATER STOPS	1	3	2	3	2	1	0

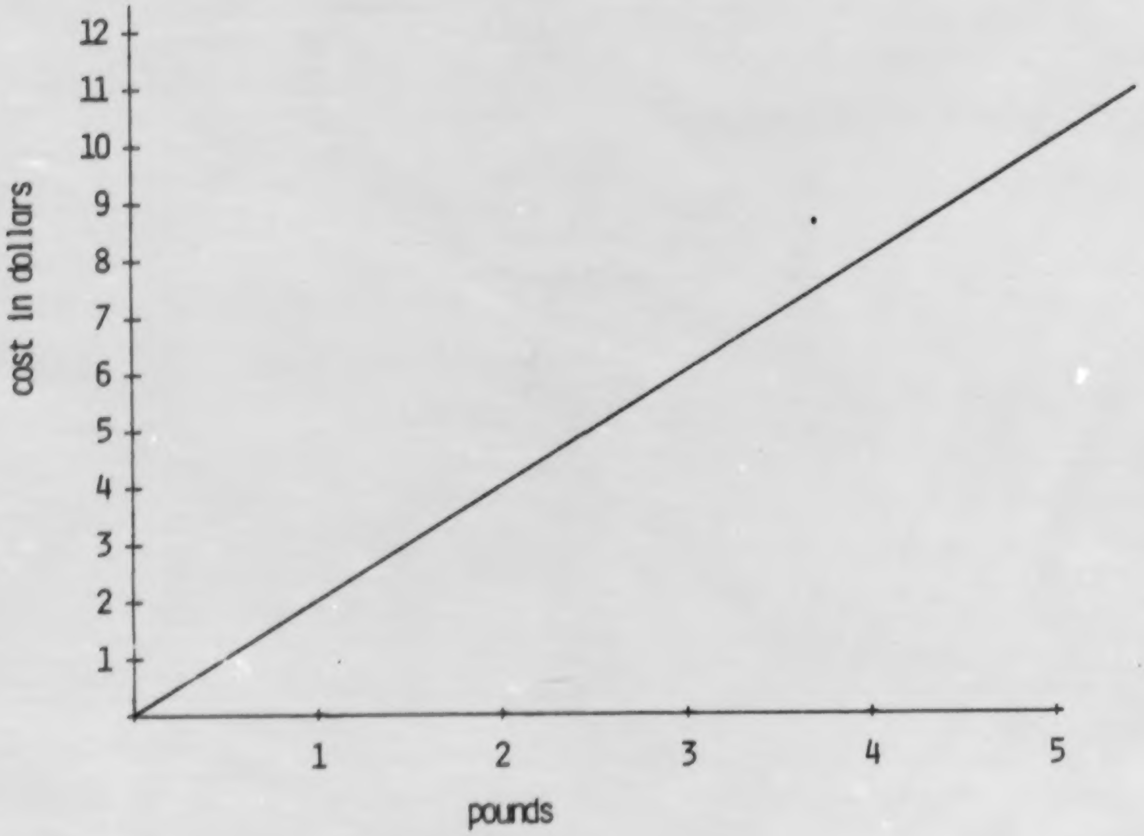
6. Estimate the correlation coefficient for the data shown in the scatter diagram at the right. Will it be closer to

a) $^+.4$ b) $^-.4$ c) 0 d) $^+.9$ e) $^-.9$



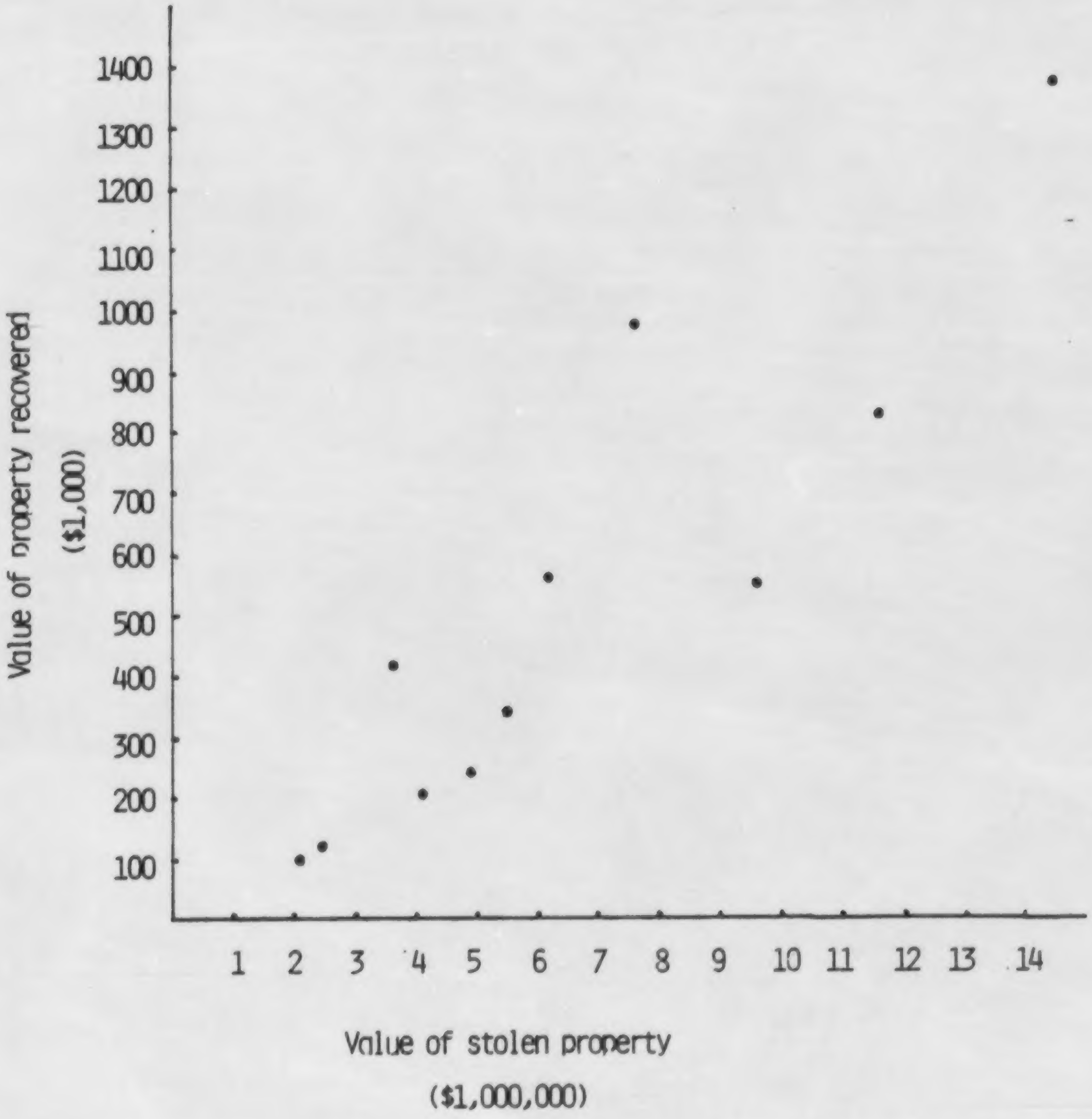
Chapter 9, Lesson 7
Transparency A

Cost of Candy

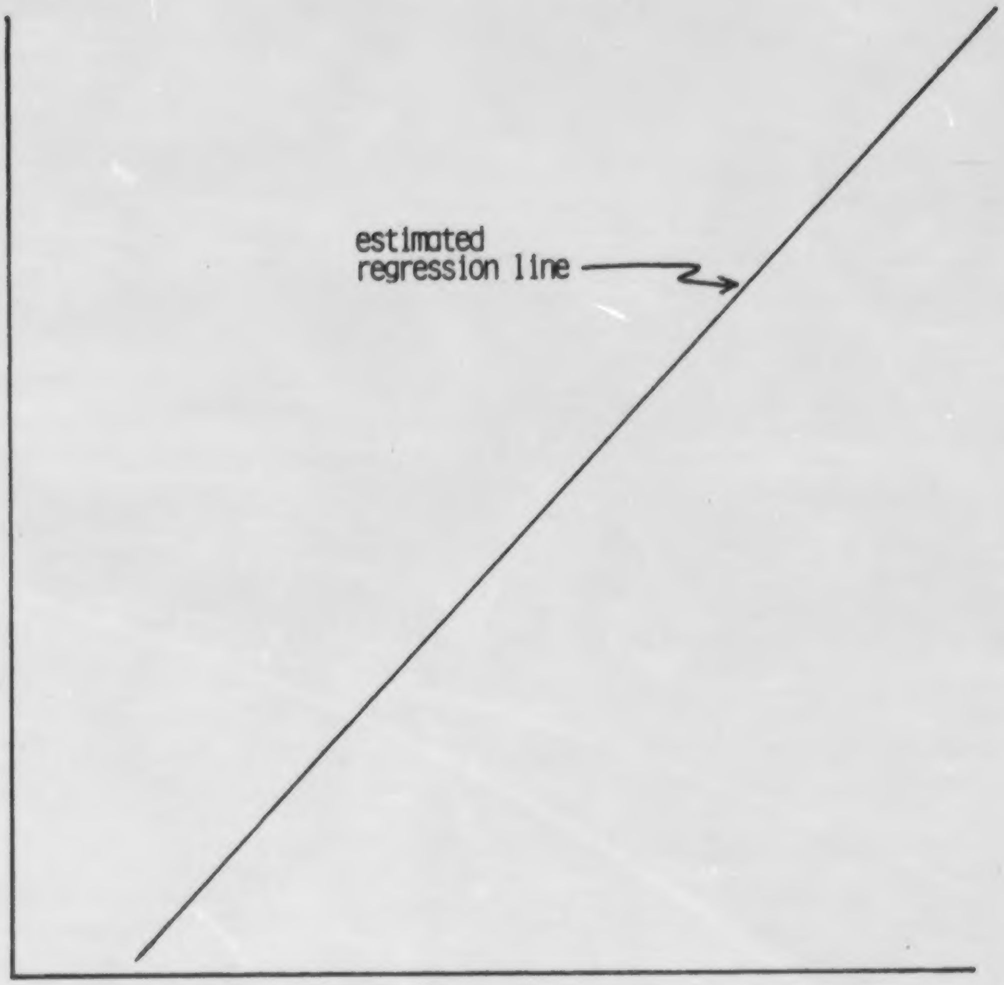


Chapter 9, Lesson 7
Transparency B

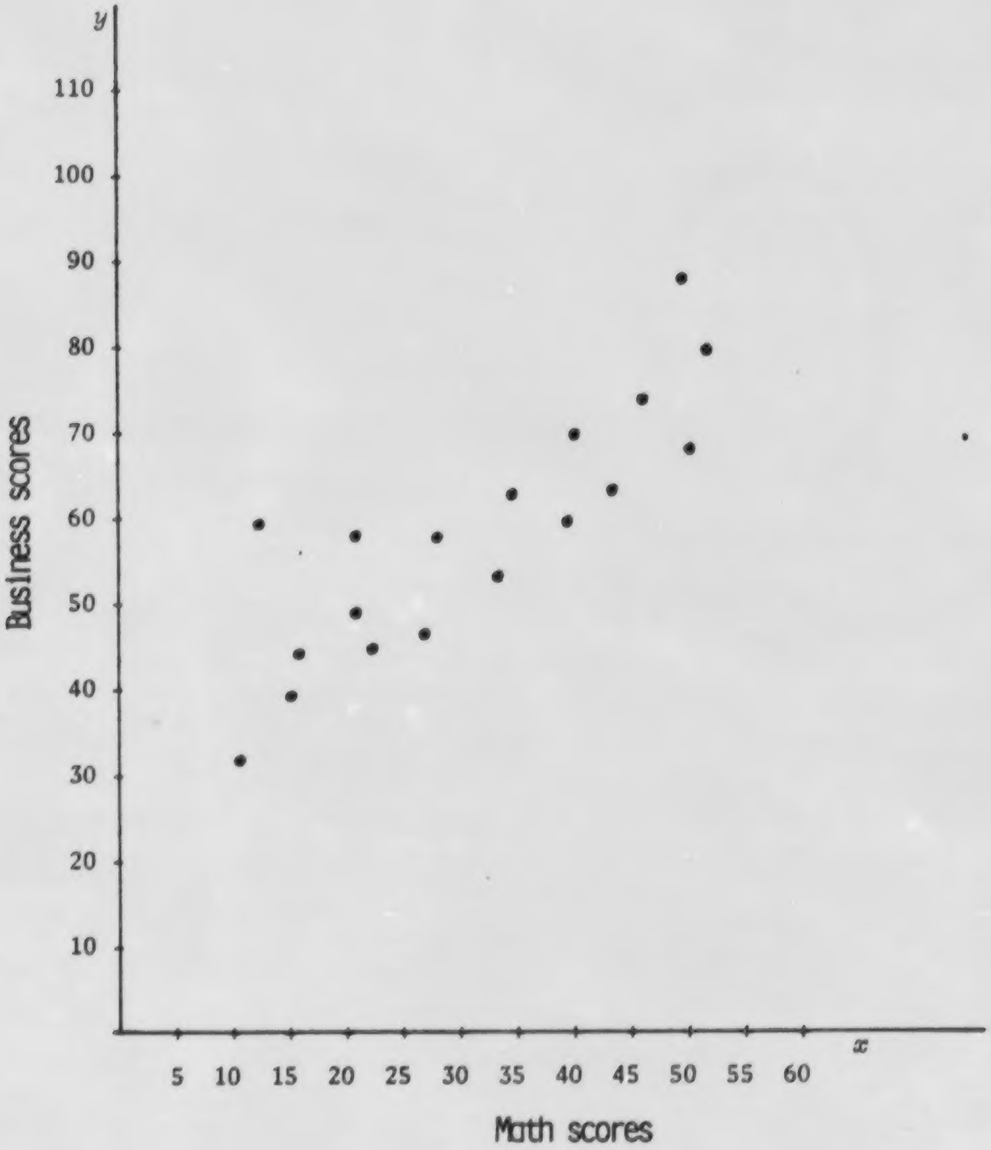
VALUE OF PROPERTY STOLEN AND PROPERTY RECOVERED
IN THE COUNTY OF HONOLULU, 1966 - 1976



Chapter 9, Lesson 7
Transparency B Overlay


estimated
regression line

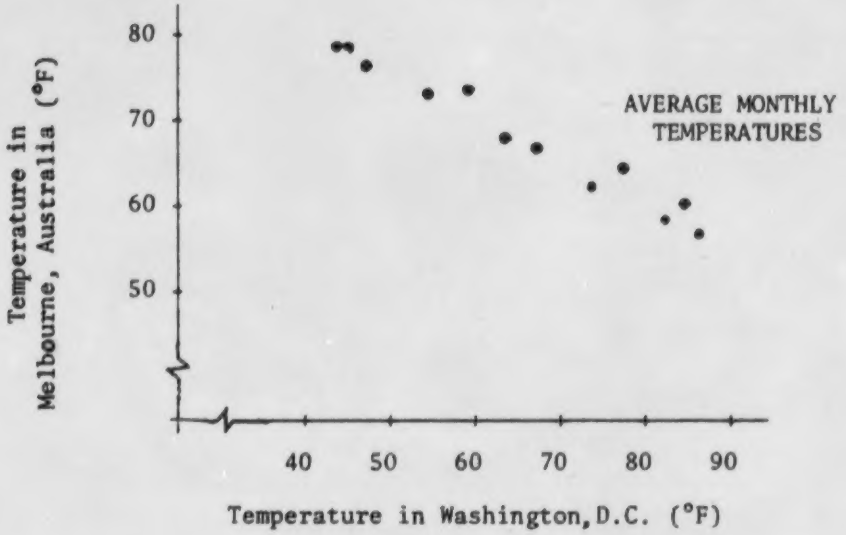
Chapter 9, Lesson 7
Transparency C



From Statistics and Probability in Modern Life, 2nd edition by Joseph Newmark. New York City: Holt, Rinehart, and Winston, 1977, p. 270.

Chapter 9, Lesson 7 Name ____________________

Worksheet 4 Date ____________________



1. Use the scatter diagram above to answer the following questions.

   a. What type of correlation does there appear to be? ____________

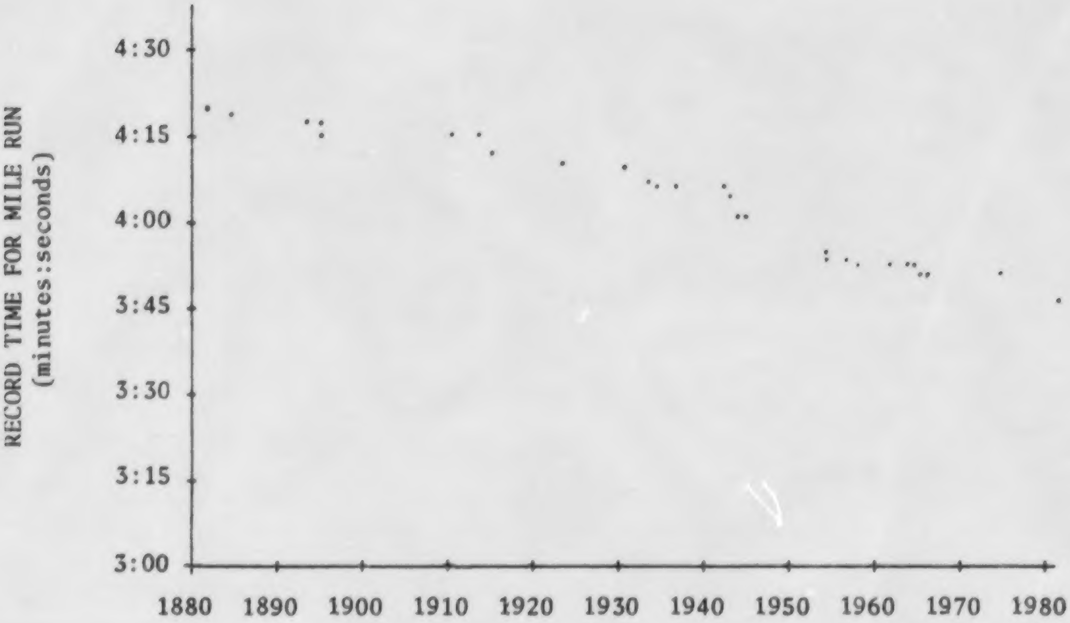
   b. Sketch the estimated regression line in the diagram above.

   c. If the temperature in Washington, D.C. averages 75°F what do you predict the average temperature in Melbourne, Australia is?

      ____

   d. If the average temperature in Washington, D.C. is 110°F what do you predict the average temperature in Melbourne is? ____________

2. Use the scatter diagram below to answer the following questions:



RECORD-SETTING TIMES FOR THE MILE RUN (1880-1980)

a. What type of correlation appears to exist? ____________________

b. Sketch the estimated regression line.

c. What do you predict the record time for running the mile will be in 1990? ____________

d. When do you predict someone will run the mile in 3 minutes flat?

________ Explain ____

____

3. Make a scatter diagram for the following information. Draw the estimated regression line for these points if appropriate. Analyze your results.

player	1	2	3	4	5	6	7	8	9	10	11	12	13
x, fouls committed	16	6	30	0	18	7	0	17	7	4	0	16	9
y, points scored	45	6	72	1	40	15	0	58	21	2	2	38	18

Basketball Statistics

4. Make a scatter diagram and sketch the estimated regression line for the following data. Use intervals of 40 (40, 80, 120, 160...) on the horizontal axis and intervals of 200 (300, 500, 700, 900...) on the vertical axis.

Hawaii Public School Expenses
1959-1976

Expenditures On Current Operations ($1,000,000)	Cost Per Pupil ($)
46.6	332
69.1	435
146.8	818
179.1	988
183.8	1007
184.1	1014
221.9	1257
232.2	1305
268.2	1503

a. What do you predict the cost per pupil will be if the expenditures are $200 million? ____________________

b. Approximately how many students attended public schools when the cost per pupil was $1014? __________

Mary has determined that the number of miles per gallon of gas that she gets depends on the weight of the objects in the trunk of her car:

Weight of Objects in Trunk (in pounds), X	30	50	80	110	120	140
Miles per gallon, Y	19	18	16	14	12	11

The estimated regression line equation for this data is:

$$y = {}^{-}.07x + 21.18$$

From Statistics and Probability in Modern Life, 2nd edition by Joseph Newmark. New York City: Holt, Rinehart, and Winston, 1977, p. 277.

Chapter 9, Lesson 9
Transparency B

Students at Haleakala High School were asked two questions:

1) What is your G.P.A.?
2) How many hours do you study each week?

Researchers found the correlation coefficient and the equation for the estimated regression line:

$r = {}^{+}.9$ $\qquad\qquad$ $y = .2x + 1.00$

Chapter 9, Lesson 9 Name ______________________

Worksheet 5 Date ______________________

1. Hōkū likes to lie in bed and listen to the crickets chirp. She noticed that the more the crickets chirped the higher the temperture seemed to be. She recorded the data for two months and found there is a correlation and, in fact, the estimated regression line has the equation

$$T = \frac{n}{4} + 40,$$

where T = temperature (F°) and n = number of chirps in one minute.

   a. Predict the temperature when a cricket chirps 150 times a minute.

   b. What do you think is true if there are zero chirps?

   c. Are there certain temperatures when this equation might not be useful?

2. The regression equation for estimating income from education for women 35-54, working full time in professional or managerial jobs is

$$I = \$400E + \$2400,$$

where I = income and E = number of years of education. Estimate the income of a woman who completed through 8th grade only. Predict the incomes of high school and college graduates.

3. Suppose the regression equation for a set of data is

$$y = 2x + 2.$$

   a. Graph the regression line.

   b. Using the graph predict the value of y when $x = 7.6$.

   c. Use the regression equation to predict y when $x = 7.6$.

   d. How do your answers from b. and c. compare? Why?

4. What is the reason for finding and using a regression equation?

Chapter 9 Name ________________________

Chapter Test Date ________________________

1. ______True or False: A scatter diagram is formed by graphing the actual pairs of data (x,y) from the sample data.

2. ______True or False: A correlation coefficient of zero represents the absence of a linear relationship.

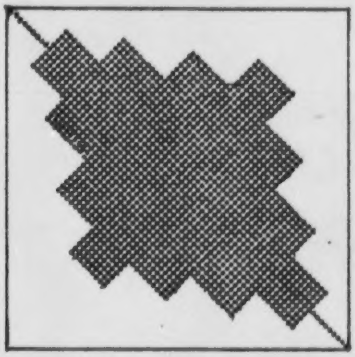
3. ______True or False: The least squares regression line is a straight line which minimizes the squared deviation between the actual data and the predicted values.

4. ______True of False: A correlation coefficient of $^-1$ represents the absence of a relationship.

5. ______True or False: The estimated regression line is drawn by connecting the points in the scatter diagram.

6. Estimate the correlation coefficient for the data shown on the diagram at the right.

   r = __________



7. The correlation between an insurance company's profits and the number of claims they have to make is:

   a) positive b) negative c) zero

8. You have correlated the speed of different cars with gasoline mileage and found that r = .35. You later discover that all speedometers were set 5 miles per hour too slow. You recompute r, using corrected speed scores. What will the new r be?

   a) $^-.30$ b) $^-.40$ c) $^-.35$ d) .35 e) $^-.07$

9. Professor Simkin concluded that there is a zero correlation between body weight and bad tempers. This means that:

   a. heavy people tend to have bad tempers.

   b. skinny people tend to have bad tempers.

   c. no one has a bad temper.

   d. everyone has a bad temper.

   e. a person with a bad temper may be heavy or skinny.

10. A correlation between college entrance exam grades and scholastic achievement was found to be $^{-}1.08$. On the basis of this you would tell the university that:

    a. the entrance exam is a good predictor of success.

    b. they should hire a new statistician.

    c. the exam is a poor predictor of success.

    d. students who do best on this exam will make the worst students.

11. A negative value of r for paired observations indicates that:

    a. individuals scoring high on one variable tend to score low on a second variable.

    b. individuals scoring high on one variable tend to score high on a second variable.

    c. there is no relationship between the two variables.

    d. the relationship is in the opposite direction to the one predicted.

    e. there is an error in the calculations.

12. If the least squares regression equation for a set of data is $y = \frac{2}{5}x - 7$, predict y when x = 12. ______________

Use the following data to answer questions 13-16.

The following results were calculated from a group of 10 people who took two algebra tests:

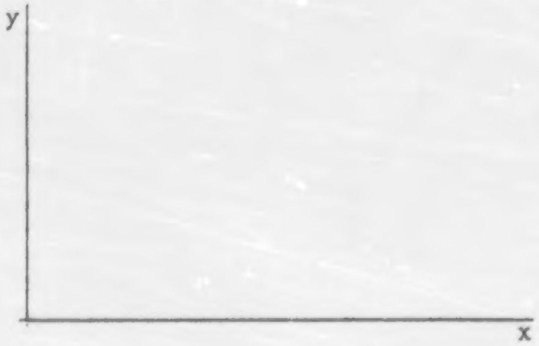
First Test (x)	Second Test (y)
14	16
17	14
11	13
5	10
8	8
15	7
6	5
9	4
2	2
3	1
$\Sigma x = 90$	$\Sigma y = 80$

$\Sigma x^2 = 1050$
$\Sigma y^2 = 880$
$\Sigma xy = 897$
$(\Sigma x)^2 = 8100$
$(\Sigma y)^2 = 6400$
$n = 10$

13. Find the coefficient of correlation.

(Remember: $r = \dfrac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{n\Sigma x^2 - (\Sigma x)^2}\,\sqrt{n\Sigma y^2 - (\Sigma y)^2}}$)

14. Draw a scatter diagram for the above data.



15. Draw the estimated regression line on the scatter diagram in #13 above.

16. Using your estimated regression line predict the score on the second test for a person who scored 10 on the first test: ______________

Things to consider when writing questions:

1. Questions should be reasonable and answerable.
2. Questions should not confuse, irritate, or offend persons.
3. Questions should be non-directional and unbiased.
4. Questions should be clear and simple but not insulting.
5. Questions should be interesting.

TYPES OF QUESTIONS

1. Closed-end questions (answers can be anticipated)
2. Open-end questions (answers can not be anticipated)
3. Control questions (questions of fact about the person who has been interviewed)
4. Questions that use a rating scale (on a scale of 1 to 10...)

Statistics Review Name ____________________

Final Project Date ____________________

A final project and minimum requirements for completing it are described below. Two people at most should work on one project. In addition to the minimum requirements listed below, the more statistics that are performed on the data, the better your project grade. However, be sure that graphical methods and analysis are appropriate to your data.

Final Project: Survey at least 40 people (20 male and 20 female). Ask them at least three related questions. Two of the questions should be factual and require single number responses. Possible topics include employment, study habits, dating, smoking, use of the library, cheating in school, sports in school, leisure time, personal habits, and so on.

Survey Sheet: Record each person's survey responses on a separate paper. (Or, have each person complete their own form.) Each survey sheet should have a place to indicate sex (M___ F___) and year in school (9___ 10___ 11___ 12___).

Minimum Requirements:

1. Title Page
2. Table of Contents
3. A sample survey sheet should be attached to this project.
4. Tally the responses to each question separately. Make at least one graph to represent each set of responses.
5. Find the mean, median, and mode for appropriate questions. Which statistic is most representative of the data? Find the standard deviation.
6. Use the responses to the two numerical questions as ordered pairs (x,y) to draw a scatter diagram.
7. Compute the correlation coefficient for the two data used to draw the scatter diagram.
8. Summarize your survey results. Can any conclusions be drawn?
9. State how the work was divided between team members and what was done by each.

Other Questions to Consider:

Would it be appropriate to discuss percentile and percentile rank for any of the data?

Should the data be analyzed in terms of male responses versus female responses? Responses from 9th graders versus 10th graders versus 11th versus 12th?

How valid do you think your results are? Was your sample biased?

What kind of predictions can be made using an estimated regression line?

Statistics Name ____________________

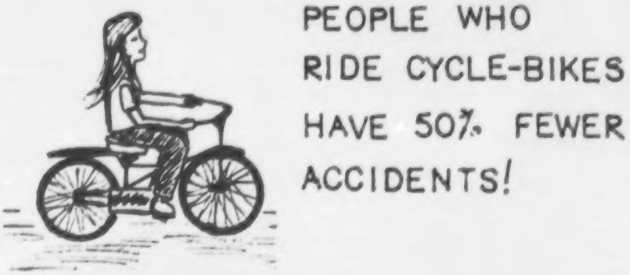
Final Exam Date ____________________

1. True or False: Descriptive statistics is a branch of statistics used to describe or summarize data related to a specific population.

2. Which of the following is used to determine the Nielson ratings of television programs?

   a. Descriptive statistics b. Inferential statistics

3. Is the following ad misleading? Why or why not?



____

____

____

____

Use the following table to find values for A, B, and C in exercises 4-6.

Age	Frequency	Cumulative Frequency	Relative Frequency	Cumulative %
13	12			
14	11			C
15	14		B	
16	12	A		
17	16			

4. A = ________

5. B = ________

6. C = ________

________ 7. You are going to make a circle graph of the months people were born. Eight people in your class of 24 students were born in April. How many degrees of the circle would this represent?

________ 8. What is the class mark for the interval 30-37?

9. What kind of graph would be appropriate to display the data below? (Choose one.)

   a. histogram c. bar graph

   b. frequency polygon d. ogive

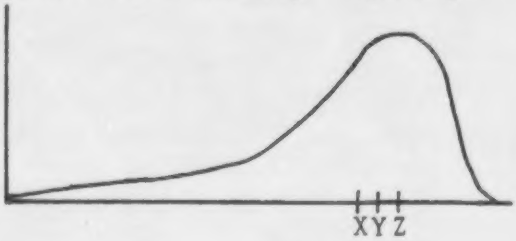
Subject	Enrollment
Gen. Math	102
Algebra	86
Geometry	41
Calculus	12

10. X, Y, and Z represent different measures of central tendency. Identify them:

X = ________________

Y = ________________

Z = ________________



11. X = {7, 3, -1, 8, 2, -4} $\Sigma(x + 2) =$ ______________

12. Y = {5, 0, 2, -3, 4, 1, -2}. What is the range of set Y?______________

13. Members of a local club compared their weekly incomes. They were: $200, $200, $225, $230, $238, $240, $250, $255, $275, $280, $290, $950, $1500. Would the mean, median, or mode provide a better description of the incomes of these people?____________ Why?______________________________

____

14. The standard deviation in a recent test was 5 points. Therefore, the variance was ____________.

15. Who got a better score on Miss Hirata's test? Hoku's z-score = -2.1 and Lautoa's z-score = 0. ________________

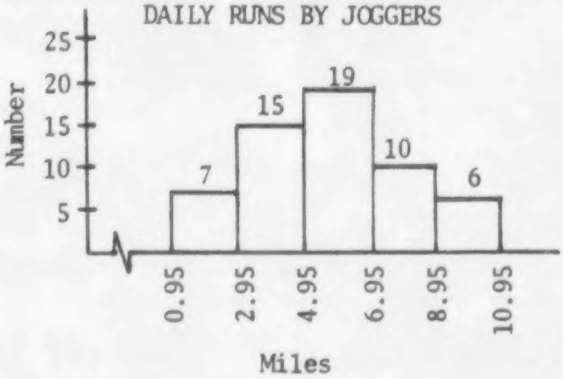
16. Students in the environmental club collected paper to recycle. The number of pounds collected by each student is listed below. Find the percentile rank of Cara.

Cara - 27
Robert- 21
Elcid - 30
Randy - 16
Dich - 24

Donn - 8
Mike - 32
Tom - 37
Lisa - 23
Nilo - 14

Pat - 15
Greg - 17
Dan - 29
Jon - 30
Keiki - 20

Use this graph to answer exercises 17-20.



17. What type of graph is shown at the left?______________

18. How many joggers are represented in this graph?______________

19. What percent of joggers are included in the fourth class interval?______________

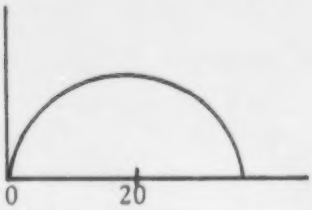
20. What is the modal interval in this graph?______________

21. Gloria scored 89% on a statistics test. John's score on the same test was in the 70th percentile. Who received the better score?____________

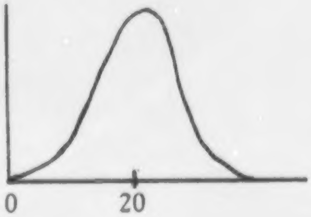
22. A score in the 50th percentile is equivalent to which measure of central tendency?____________________

23. Which distribution below has the smaller variance?

a.



b.



24. The following scores were obtained on a recent test: 25, 29, 41, 36, 36, 37, 38, 39, 39, 39, 41, 52, 58, 59, 60. The teacher computed various measures of central tendency and measures of variation before noticing that an error had been made. The score of 58 should have been a 52. Which of the following will the teacher have to recompute?

a. median b. mode c. range d. standard deviation

25. True or False: A correlation coefficient of $^{-}1$ means that individuals obtaining high scores on one variable tend to obtain low scores on a second variable.

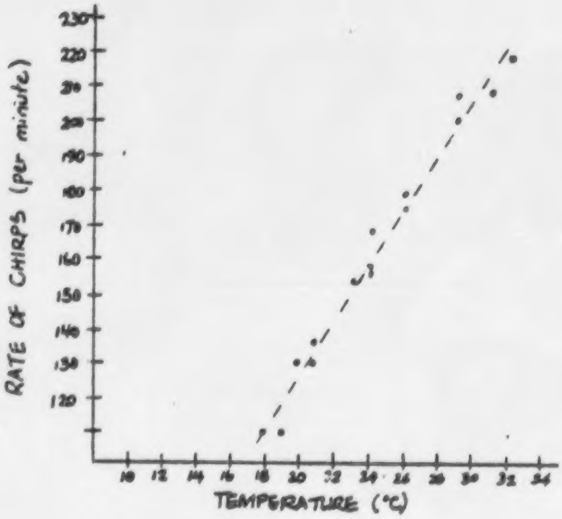
26. What is the maximum value of the correlation coefficient that can be obtained from a set of scores? _________________

27. Do speed of travel and travel time have a positive correlation, negative correlation, or zero correlation?_____________________

28. Which set of paired observations shows a stronger linear relation: one in which $r = -0.8$ or $r = +0.7$? ____________________

29. Suppose that the regression equation for a set of data was $y' = 4 + 2(x - 1)$. Predict y' if $x = 11$.

30. The scatter diagram to the right shows the temperature and the corresponding rate of cricket chirps. Use the estimated regression line shown to predict the number of cricket chirps when the temperature is 28° C.



31. What is the purpose of the regression equation?

ANSWER KEYS

WORKSHEET ANSWER KEY

Statistics Course Introduction, Worksheet 1

1. Statistics and Probability in Modern Life 2. Joseph Newmark
3. Holt, Rinehart & Winston 4. 1977 5. 15
6. Linear Correlation and Regression 7. 53 8. viii
9. Factorials 10. Tells what the chapter will discuss
11. Self-study guide 12. 21st percentile 13. 69 14. mode
15. Population standard deviation 16. Percentile rank of x

Chapter 2, Lesson 1, Worksheet 1

DECIMAL DIGITS OF π:

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
No.	Tally	Frequency f	Cumulative Frequency (c.f.)	Relative Frequency (r.f. or %)	Cumulative Per Cent (c %)
0	𝍸 𝍸	10	10	$\frac{10}{120} = .08\overline{3}$	$8.\overline{3}$ %
1	𝍸 𝍸	10	20	$\frac{10}{120} = .08\overline{3}$	$16.\overline{6}$ %
2	𝍸 𝍸 𝍸	15	35	$\frac{15}{120} = .125$	$29.1\overline{6}$ %
3	𝍸 𝍸 |||	13	48	$\frac{13}{120} = .108\overline{3}$	40 %
4	𝍸 𝍸 ||	12	60	$\frac{12}{120} = .1$	50 %
5	𝍸 ||||	9	69	$\frac{9}{120} = .075$	57.5 %
6	𝍸 𝍸 ||	12	81	$\frac{12}{120} = .1$	67.5 %
7	𝍸 ||||	9	90	$\frac{9}{120} = .075$	75 %
8	𝍸 𝍸 𝍸 |	16	106	$\frac{16}{120} = .1\overline{3}$	$88.\overline{3}$ %
9	𝍸 𝍸 ||||	14	120	$\frac{14}{120} = .11\overline{6}$	100 %

Chapter 2, Lesson 1, Worksheet 1 (cont'd)

PARAGRAPH LETTER FREQUENCY

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
Letter	Tally	Frequency f	Cumulative Frequency** (c.f.)	Relative Frequency (r.f.)	Cumulative Percent (c %)
A	卌 卌 卌 卌 卌 |	26	26	26/285 ≈ .091	9.1 %
B	||||	4	30	4/285 ≈ .014	10.5 %
C	卌 |	6	36	6/285 ≈ .021	12.6 %
D	卌 卌 |	11	47	11/285 ≈ .039	16.5 %
E	卌 卌 卌 卌 卌 卌 卌	35	82	35/285 ≈ .123	28.8 %
F	卌 |||	8	90	8/285 ≈ .028	31.6 %
G	卌	5	95	5/285 ≈ .018	33.3 %
H	卌 卌 ||	12	107	12/285 ≈ .042	37.5 %
I	卌 卌 ||||	14	121	14/285 ≈ .049	42.5 %
J	|||	3	124	3/285 ≈ .011	43.5 %
K	|	1	125	1/285 ≈ .004	43.9 %
L	卌 ||||	9	134	9/285 ≈ .032	47.0 %
M	||	2	136	2/285 ≈ .007	47.7 %
N	卌 卌 卌 卌 |	21	157	21/285 ≈ .074	55.1 %
O	卌 卌 卌 卌 卌 |||	28	185	28/285 ≈ .098	64.9 %
P	卌 ||	7	192	7/285 ≈ .025	67.4 %
Q		0	192	0/285 ≈ 0	67.4 %
R	卌 卌 卌 ||||	19	211	19/285 ≈ .067	74.0 %
S	卌 卌 卌 ||||	19	230	19/285 ≈ .067	80.7 %
T	卌 卌 卌 卌 ||||	24	254	24/285 ≈ .084	89.1 %
U	卌 卌 |	11	265	11/285 ≈ .039	93.0 %
V	||	2	267	2/285 ≈ .007	93.7 %
W	卌 卌	10	277	10/285 ≈ .035	97.2 %
X		0	277	0/285 ≈ 0	97.2 %
Y	卌 |||	8	285	8/285 ≈ .028	100.0 %
Z		0	285	0/285 ≈ 0	100.0 %

a. What are the five most frequently occuring letters? E, O, A, T, N

b. What are the five least frequently occuring letters? (Q, X, Z), K, (M, V)

Chapter 2, Lesson 2, Worksheet 2

First five are the same, but in a different order; Five of the last six are the same, but in a different order.

THE HARDEST THING FOR
CBK BNZOKWC CBUGA VMZ

TWO PEOPLE TO DO IS
CIM LKMLPK CM OM UW

TO KEEP A SECRET
CM FKKL N WKEZKC.

Chapter 2, Lesson 4, Worksheet 2

1. a. 20
   b. 11
   c. 8.5
   d. 42.5
   e. 27
   f. 32
   g. 1148.5

2. $\frac{85 - 21}{8} = 8$; Therefore, intervals 21-28, 29-36, 37-44, 45-52, 53-60, 61-68, 69-76, and 77-85 can be used. (Other solutions possible.)

3. $45 - 6 = 39$; Each class includes 4 integers; therefore, there are $\frac{39}{4} = 9\frac{3}{4}$ or 10 classes when rounded.

4. $\frac{203 - 86}{10} = 11.7$, or 12 when rounded

   One possible set of caass intervals: 86-97, 98-109, 110-121, 122-133, 134-145, 146-157, 158-169, 170-181, 182-193, 194-205.

Chapter 2, Lesson 9, Worksheet 3

1. .2
2. .25
3. .167
4. .313
5. .047
6. .948
7. .063
8. .25

9. 72
10. 61.2
11. 14
12. 75
13. 14.24
14. 5.4
15. .06
16. 216

17. 83%
18. 25.4%
19. 38.71%
20. 103%
21. 5.67%
22. 40%
23. 200%
24. 160%

25. .54
26. .278
27. .3604
28. .07
29. .019
30. 1.56
31. .083
32. .0091

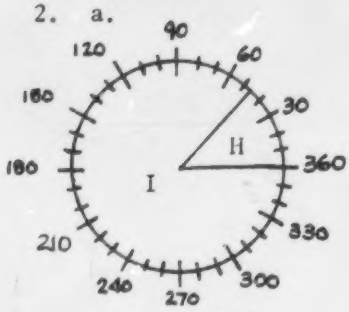
Chapter 2, Lesson 11, Worksheet 4

1. a. A = 150°
B = 210°

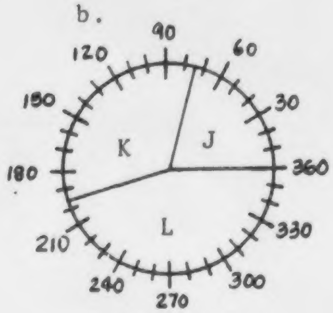
b. C = 230°
D = 130°

c. E = 65°
F = 115°
G = 180°

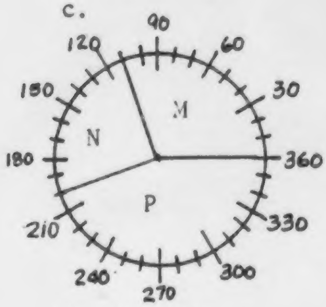
2. a.


90
60
30
360
330
300
270
240
210
180
150
120
H
I

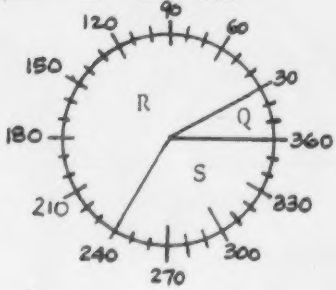
b.


90
60
30
360
330
300
270
240
210
180
150
120
J
K
L

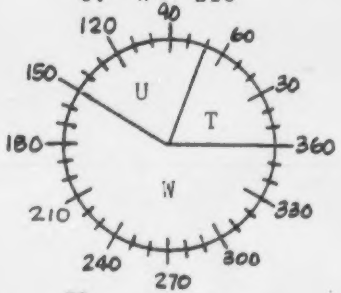
c.


90
60
30
360
330
300
270
240
210
180
150
120
M
N
P

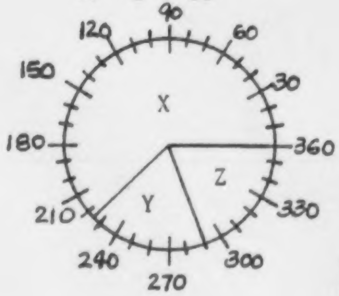
d. S = 120°


90
60
30
360
330
300
270
240
210
180
150
120
R
Q
S

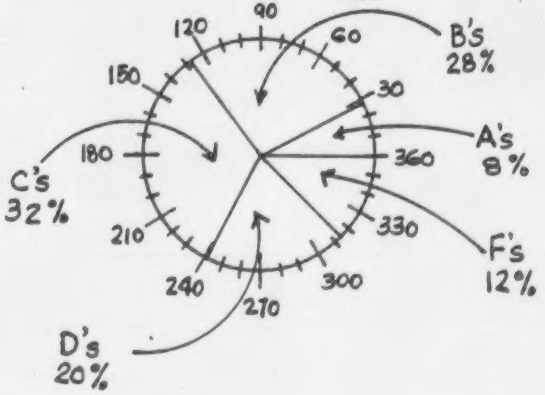
e. W = 210°


90
60
30
360
330
300
270
240
210
180
150
120
U
T
W

f. Z = 65°


90
60
30
360
330
300
270
240
210
180
150
120
X
Y
Z

3.



GRADES IN MRS. ABELSON'S CLASS

a. 2

b. 7

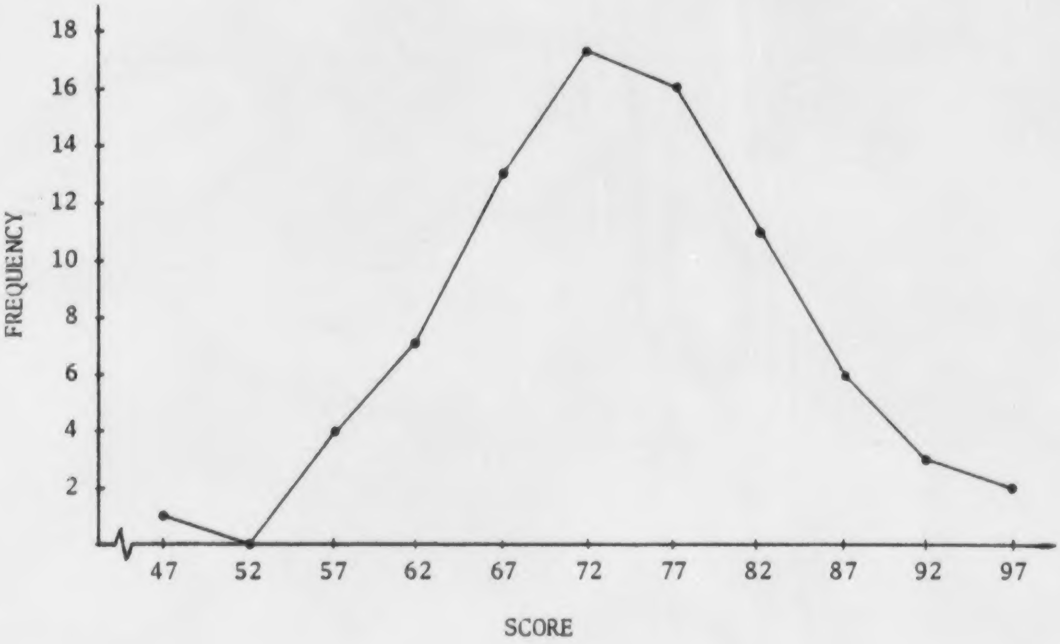
c. 8

d. 5

Chapter 2, Lesson 14, Worksheet 5

FINAL EXAM RESULTS

class	interval	true limits (class boundary)	class mark	f	cf	c%
		44.5 - 49.5	47		1	1.25
		49.5 - 54.5	52		1	1.25
		54.5 - 59.5	57		5	6.25
		59.5 - 64.5	62		12	15.00
		64.5 - 69.5	67		25	31.25
		69.5 - 74.5	72		42	52.50
		74.5 - 79.5	77		58	72.50
		79.5 - 84.5	82		69	86.25
		84.5 - 89.5	87		75	93.75
		89.5 - 94.5	92		78	97.50
		94.5 - 99.5	97		80	100.00

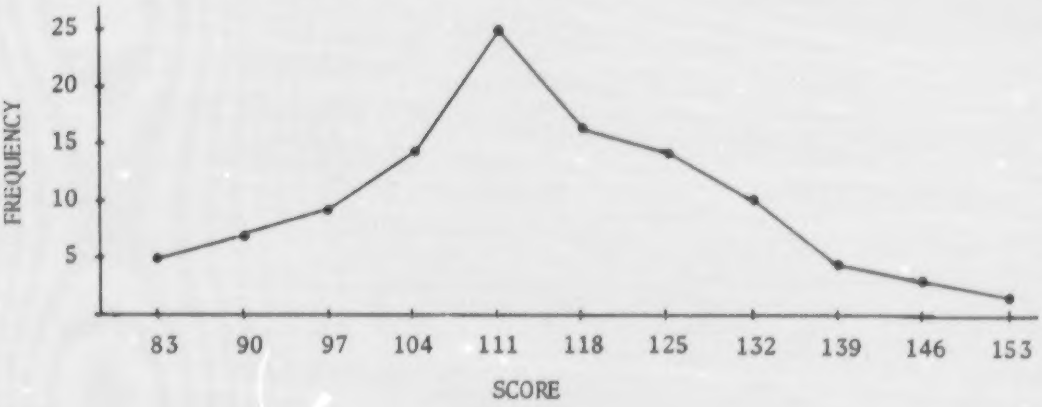


Chapter 2, Lesson 15, Worksheet 6

1.

Score	Class Mark	Tally	Frequency
80 - 86	83	卌	5
87 - 93	90	卌 ||	7
94 - 100	97	卌 ||||	9
101 - 107	104	卌 卌 ||||	14
108 - 114	111	卌 卌 卌 卌 卌	25
115 - 121	118	卌 卌 卌 |	16
122 - 128	125	卌 卌 ||||	14
129 - 135	132	卌 卌	10
136 - 142	139	卌	5
143 - 149	146	|||	3
150 - 156	153	||	2

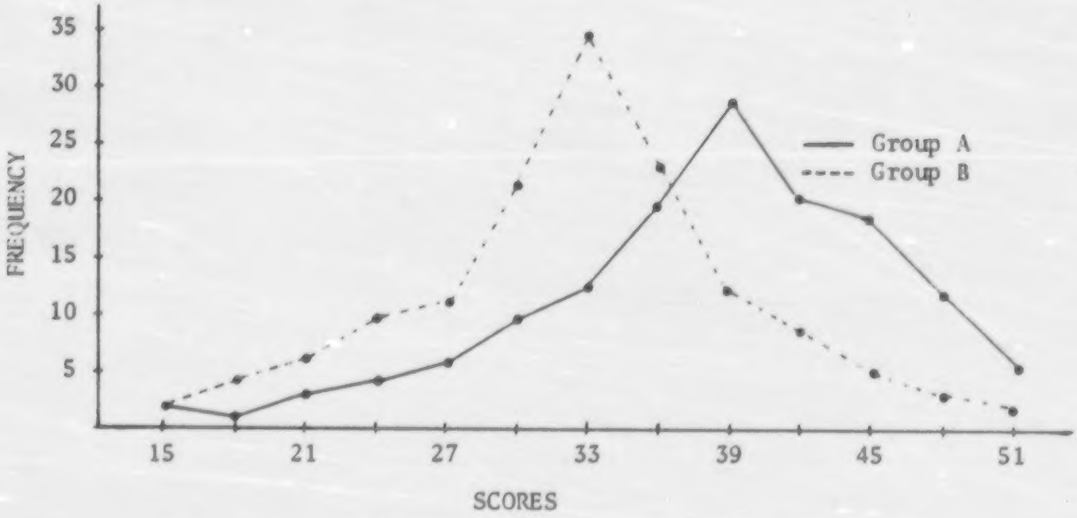
IQ SCORES OF
HIGH SCHOOL STUDENTS



(The graph is close to being a normal curve.)

Chapter 2, Lesson 15, Worksheet 6 (cont'd)

2. a. READING ABILITY SCORES



b. Group A appears to have the better ability.

Chapter 2, Lesson 16, Worksheet 7

1. a. 40%
   b. 10%
   c. January

2.

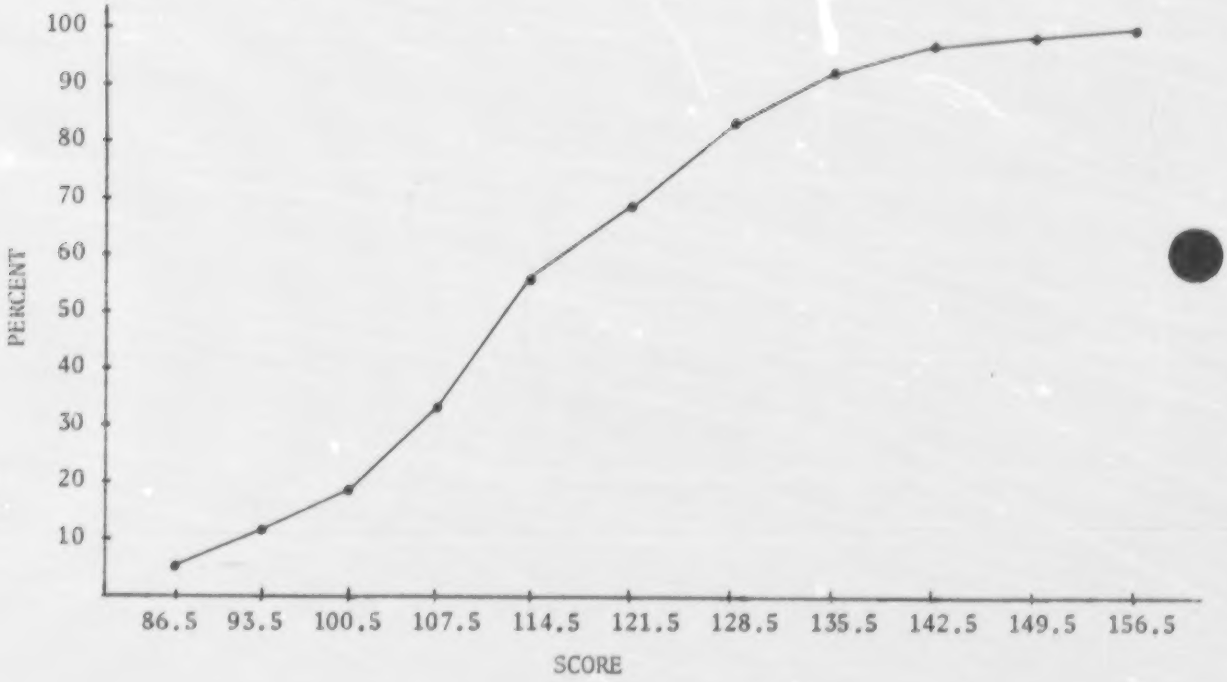
Age	Number	Cumulative Frequency	Cumulative Percent
		37	13.4
		60	21.7
		104	37.5
		150	54.2
		192	69.3
		240	86.7
		277	100.0

3.

From W6:

Score	f	Cum. freq.	Cum %
80 - 86	5	5	4.5
87 - 93	7	12	10.9
94 - 100	9	21	19.1
101 - 107	14	35	31.8
108 - 114	25	60	54.5
115 - 121	16	76	69.1
122 - 128	14	90	81.8
129 - 135	10	100	90.9
136 - 142	5	105	95.5
143 - 149	3	108	98.2
150 - 156	2	110	100.0

IQ SCORES OF HIGH SCHOOL STUDENTS



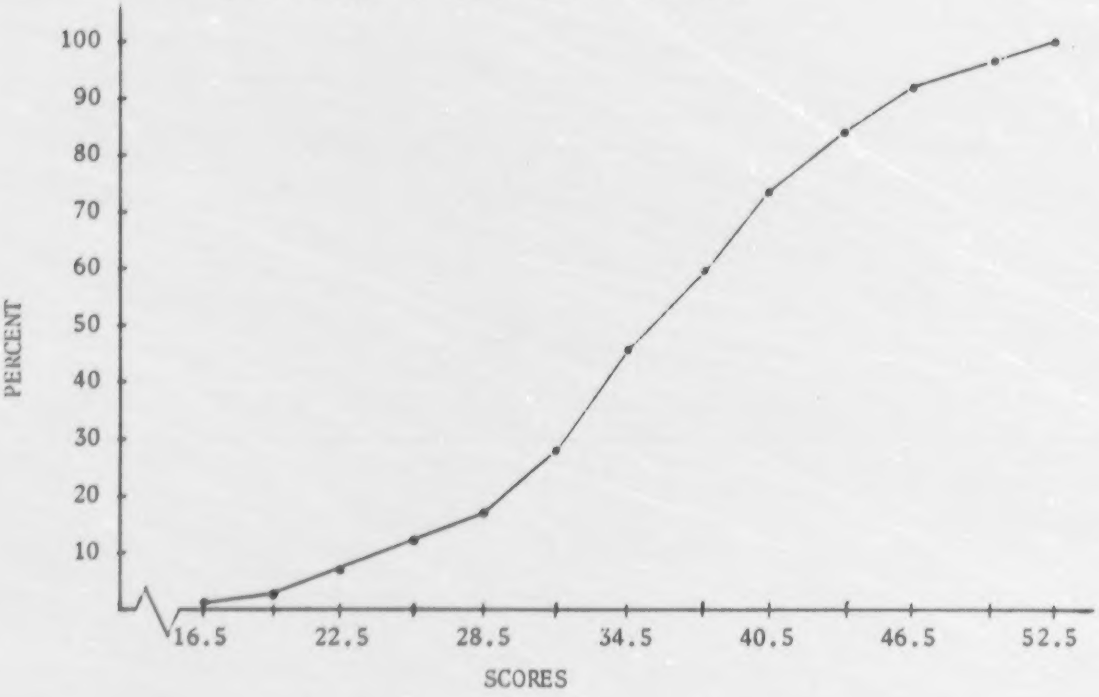
(answers will vary depending upon intervals chosen)

Chapter 2, Lesson 16, Worksheet 7 (cont'd)

4.

interval	f	Cum. freq.	Cum. %
14 - 16	4	4	1.4
17 - 19	5	9	3.2
20 - 22	9	18	6.4
23 - 25	13	31	11.1
26 - 28	17	48	17.1
29 - 31	30	78	27.9
32 - 34	47	125	44.6
35 - 37	42	167	59.6
38 - 40	40	207	73.9
41 - 43	28	235	83.9
44 - 46	23	258	92.1
47 - 49	15	273	97.5
50 - 52	7	280	100.0

READING ABILITY SCORES FOR SOPHOMORES



Chapter 2, Lesson 18, Worksheet 8

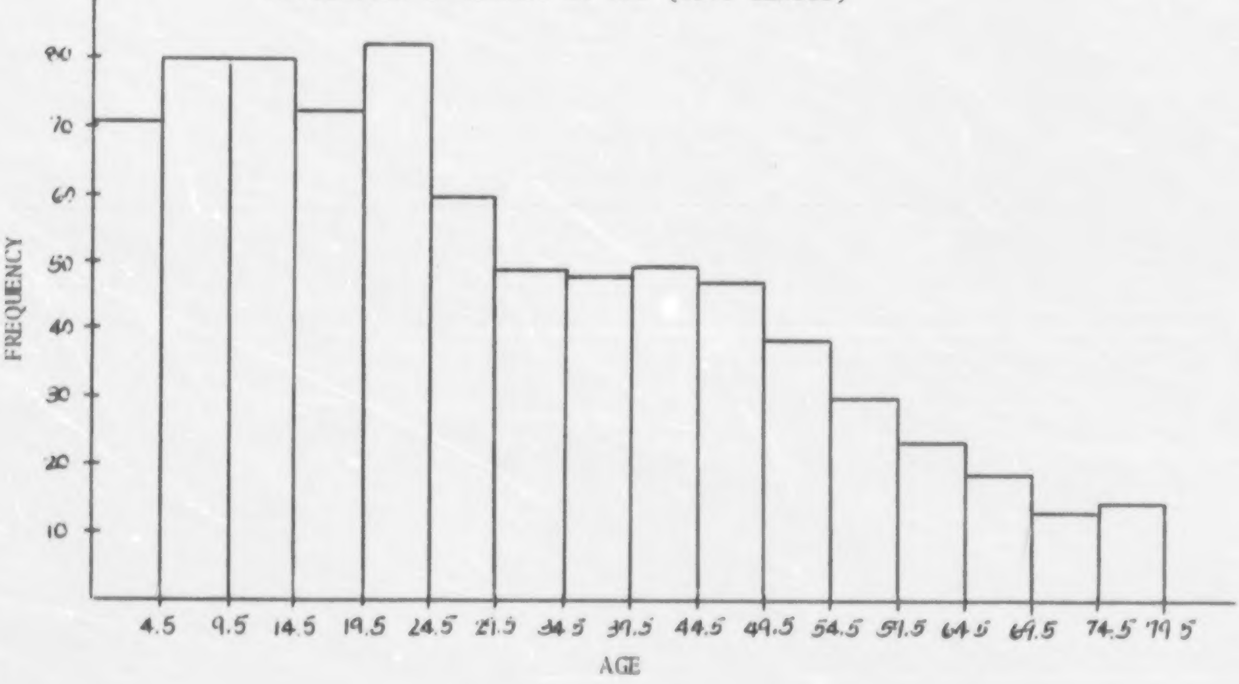
1. a.

AGE OF HAWAII POPULATION (1970 CENSUS)

Age	Mid-point	True Limits	Frequency	Relative Frequency	Cumulative Frequency	Cumulative Percent
under 5	2.5	0 - 4.5	71	71/770	71	9.2
5 - 9	7	4.5 - 9.5	80	80/770	151	19.6
10 - 14	12	9.5 - 14.5	80	80/770	231	30
15 - 19	17	14.5 - 19.5	72	72/770	303	39.4
20 - 24	22	19.5 - 24.5	82	82/770	385	50
25 - 29	27	24.5 - 29.5	60	60/770	445	57.8
30 - 34	32	29.5 - 34.5	48	48/770	493	64.0
35 - 39	37	34.5 - 39.5	47	47/770	540	70.1
40 - 44	42	39.5 - 44.5	49	49/770	589	76.5
45 - 49	47	44.5 - 49.5	46	46/770	635	82.5
50 - 54	52	49.5 - 54.5	38	38/770	673	87.4
55 - 59	57	54.5 - 59.5	30	30/770	703	91.3
60 - 64	62	59.5 - 64.5	23	23/770	726	94.3
65 - 69	67	64.5 - 69.5	18	18/770	744	96.6
70 - 74	72	69.5 - 74.5	12	12/770	756	98.2
75 and over		74.5+	14	14/770	770	100.0

b.

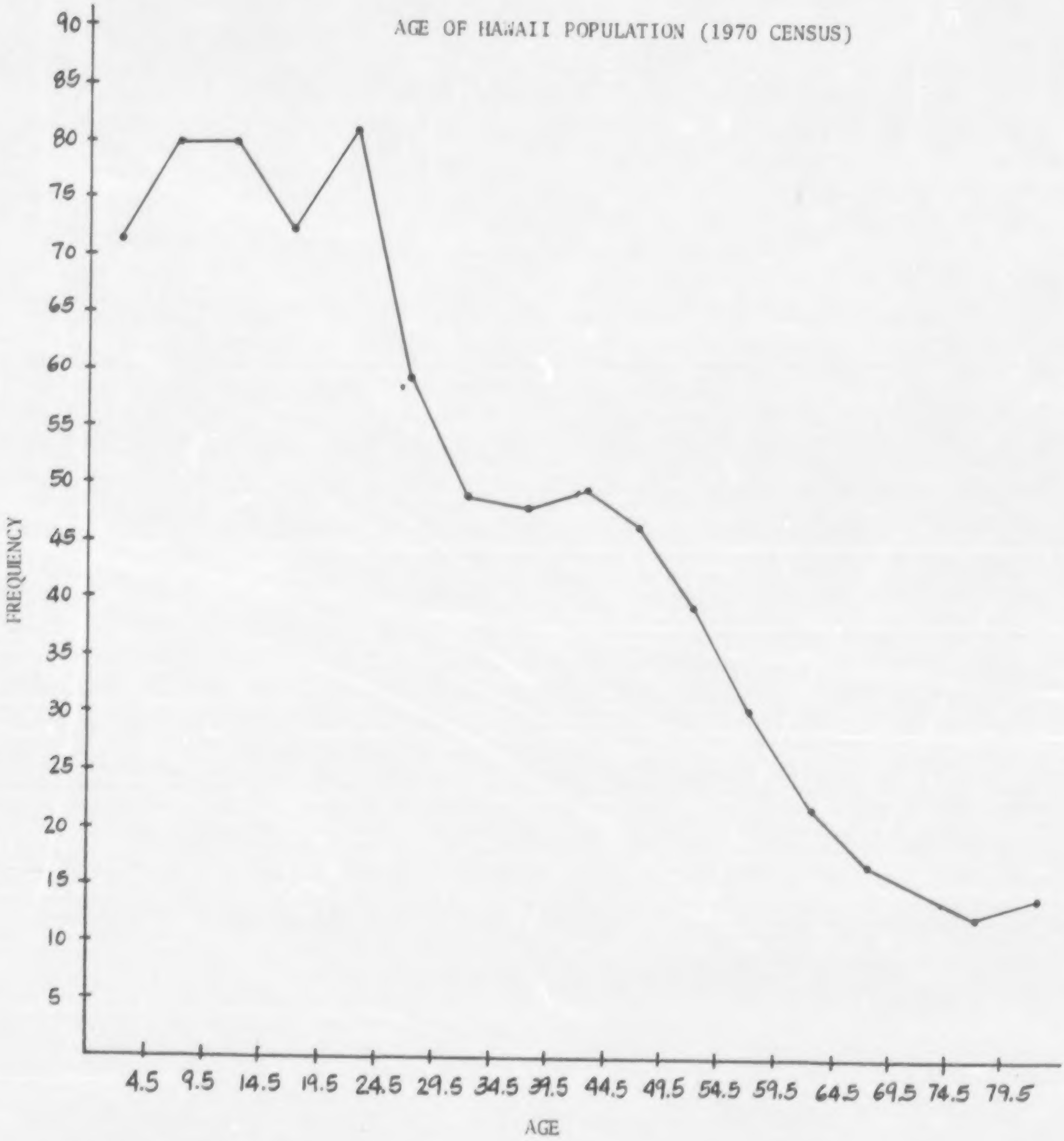
POPULATION OF HAWAII BY AGE (1970 CENSUS)



(HISTOGRAM)

Chapter 2, Lesson 18, Worksheet 8 (cont'd)

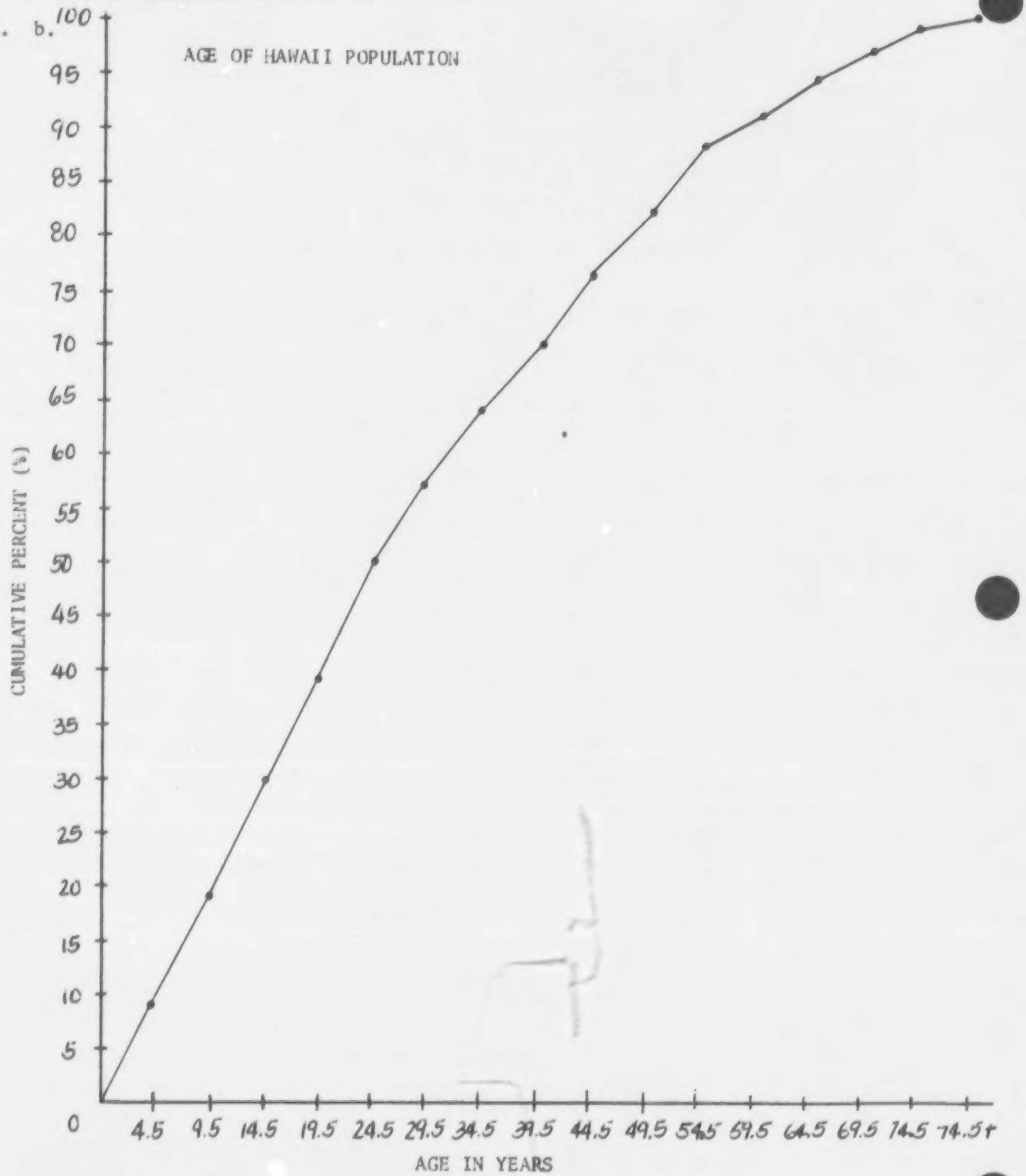
1. b.



(FREQUENCY POLYGON)

Chapter 2, Lesson 18, Worksheet 8 (cont'd)

1. b.



(OGIVE)

Chapter 2, Lesson 18, Worksheet 8 (cont'd)

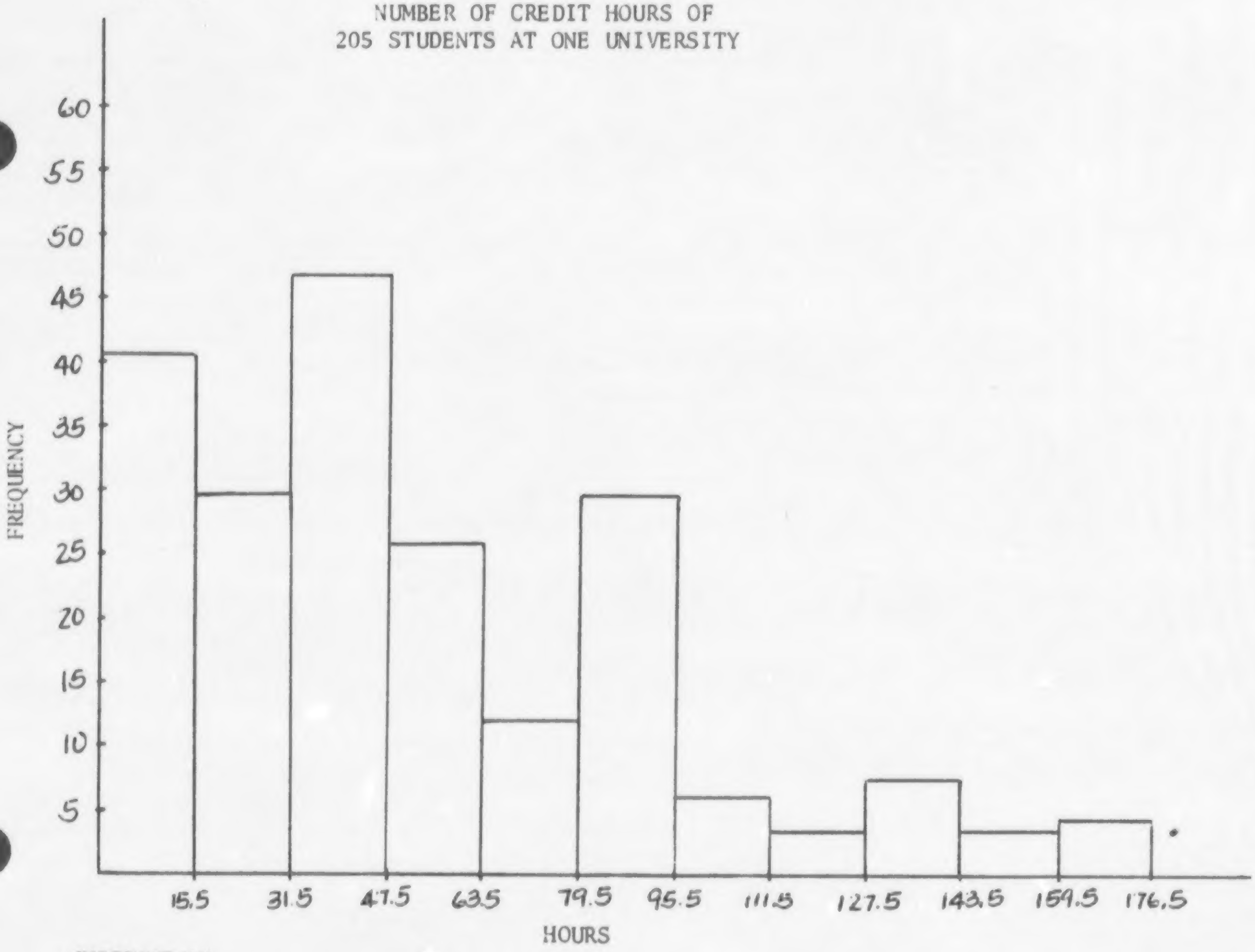
2. a.

NUMBER OF CREDIT HOURS OF
205 STUDENTS AT ONE UNIVERSITY

Hours	Midpoint	True Limits	Frequency	Relative Frequency	Cumulative Frequency	Cumulative Percent
0 - 15	7.5	0 - 15.5	41	41/205	41	20
16 - 31	23.5	15.5 - 31.5	29	29/205	70	34.1
32 - 47	39.5	31.5 - 47.5	47	47/205	117	57.1
48 - 63	55.5	47.5 - 63.5	24	24/205	141	68.9
64 - 79	71.5	63.5 - 79.5	12	12/205	153	74.6
80 - 95	87.5	79.5 - 95.5	29	29/205	182	88.8
96 - 111	103.5	95.5 - 111.5	6	6/205	188	91.7
112 - 127	119.5	111.5 - 127.5	3	3/205	191	93.2
128 - 143	135.5	127.5 - 143.5	7	7/205	198	96.6
144 - 159	151.5	143.5 - 159.5	3	3/205	201	98.0
160 - 176	168.0	159.5 - 176.5	4	4/205	205	100.0

2. b.

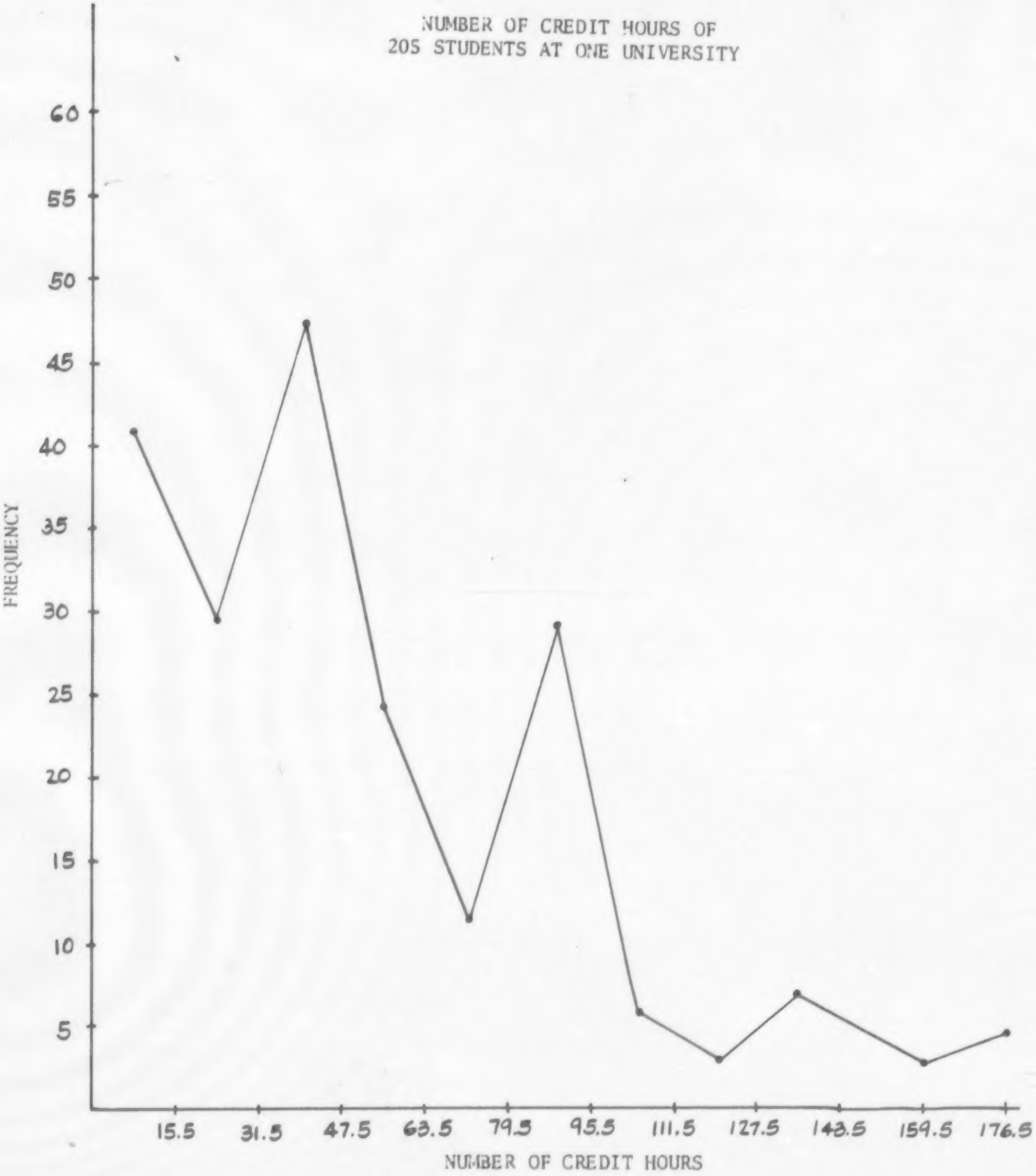
NUMBER OF CREDIT HOURS OF
205 STUDENTS AT ONE UNIVERSITY



(HISTOGRAM)

Chapter 2, Lesson 18, Worksheet 8 (cont'd)

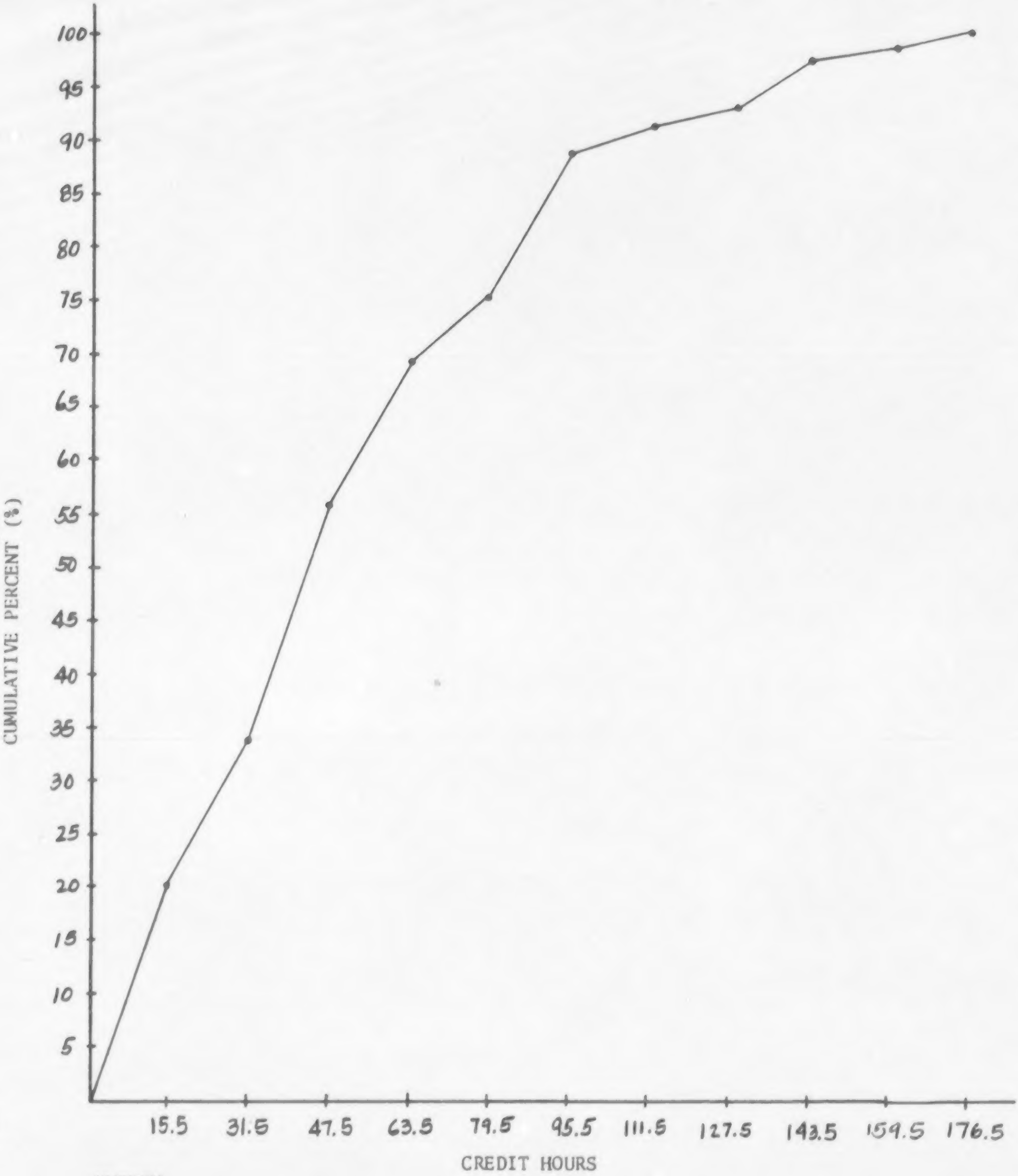
2. b.



(FREQUENCY POLYGON)

Chapter 2, Lesson 18, Worksheet 8 (cont'd)

2. b.



(OGIVE)

Chapters 3 & 4, Lesson 1, Worksheet 1

1. Maybe. Second highest score might still be a failing grade.

2. 20% of 85 = .2 x 85 = 7

3. No. It doesn't say what a perfect score is. Maybe George had a perfect score.

4. a. 7

   b. 40%

5. Not necessarily. The top 10% of the contestants might have all made baskets 100% of the time.

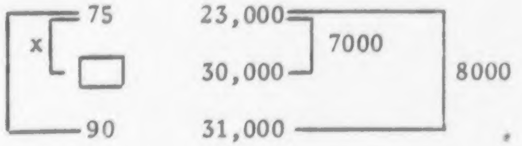
6. a. No

   b. 97.5%

Chapters 3 & 4, Lesson 2, Worksheet 2

1. 10 2. 25 3. 40% 4. 75th

5. 25

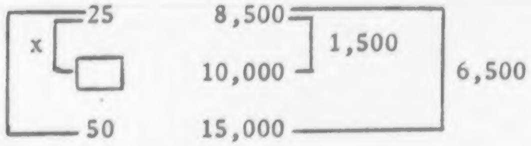

75
x
90
23,000
7000
30,000
31,000
8000

$$\frac{7{,}000}{8{,}000} = \frac{x}{15}$$

$$x = 13.1$$

$$75 + 13.1 = \underline{88.1}$$

6. 25

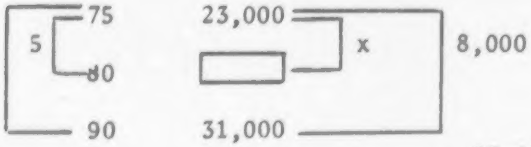

25
x
50
8,500
1,500
10,000
15,000
6,500

$$\frac{1{,}500}{6{,}500} = \frac{x}{25}$$

$$x = 5.8$$

$$25 + 5.8 = \underline{30.8}$$

7. 15


75
5
80
90
23,000
x
31,000
8,000

$$\frac{5}{15} = \frac{x}{8{,}000}$$

$$x = 2666.67$$

$$23{,}000 + 2{,}666.67 = \underline{25{,}666.67}$$

Chapters 3 & 4, Lesson 5, Worksheet 3

1. a. mode - you want to sell the most number of shoes.
   b. Answers will vary
   c. median
   d. mean

2. Mean. There are usually minimum age requirements for entrance. The age of most people at the disco will be within a limited interval. However, there will be a few older people there. These "extreme" values for age will influence the value of the mean.

3. $\overline{x} = \frac{\Sigma x}{n} \Rightarrow 16 = \frac{52 + x}{4} \Rightarrow x = 12$

4. 5'6" = 66"
   6'5" = 77"
   $\overline{x} = \frac{10(66") + 77"}{11}$
   $\overline{x} = 67" = 5'7"$

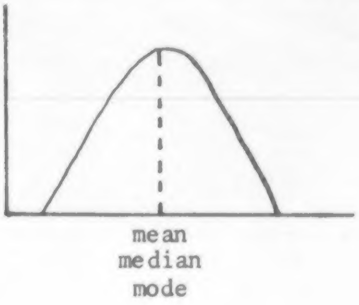
5. a. mean = 46.6 median = 48 no mode
   b. mean = 41.6 median = 43 no mode

6. a. mean = $^{-}34.\overline{3}$ median = $^{-}36$ no mode
   b. mean = $^{-}4.\overline{3}$ median = $^{-}6$ no mode

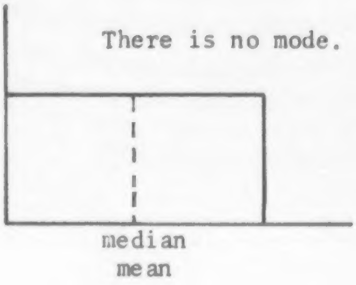
7. The values of the mean, median, and mode increase (or decrease) by the same amount that each score is changed.

Chapters 3 & 4, Lesson 6, Worksheet 4

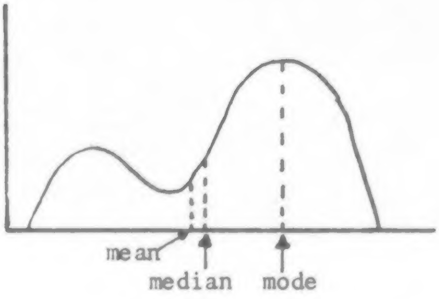
1. a.



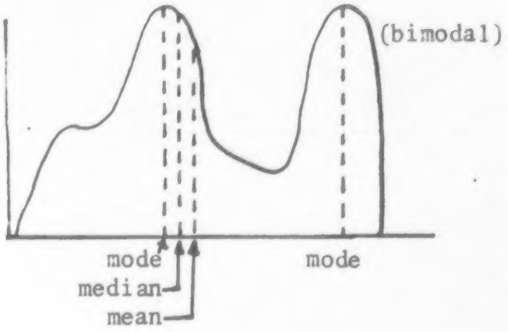
b.



c.

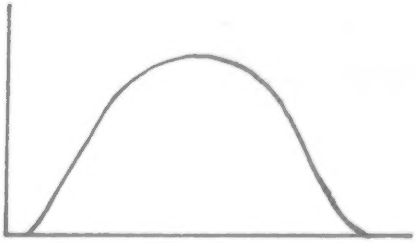


d.



2. a. answers vary
   b. median or mean
   c. answers vary
   d. median or mean

3.



Answers will vary.
This is one possibility.
Graphs will be symmetric.

4. The data set is not symmetric. There are some extreme values at the lower end.

Chapters 3 & 4, Lesson 8, Worksheet 5

1. $\bar{x} = \frac{\Sigma xf}{\Sigma f}$

2 a.

Class Mark	x · f
4	4
9	27
14	98
19	76
24	72
29	58

b. $\bar{x} = \frac{\Sigma xf}{\Sigma f} = \frac{335}{20} = 16.75$

c. 12 - 16

d. 20

e. between the $\underline{10^{th}}$ and $\underline{11^{th}}$ piece of ranked data.

f. 12 - 16

g. 12 - 16

3. mean : 25.76

median interval : 25 - 31

modal interval : 32 - 38

4. mean : 5.72

median interval : 3 - 5

modal interval : 0 - 2

Chapters 3 & 4, Lesson 9, Worksheet 6

1. $\bar{x} = \frac{20(\$25) + 50(\$15) + 30(\$20)}{20 + 50 + 30} = \frac{\$1850}{100} = \$18.50$

2. $\bar{x} = \frac{25(43) + 20(38)}{25 + 20} = \frac{1835}{200} = 40.\overline{7}$

3. $\bar{x} = \frac{.12(\$100) + .18(\$50) + .21(\$50)}{100 + 50 + 50} = \frac{31.5}{200} = .1575 = 15.75\%$

4. $\bar{x} = \frac{\text{total \# of pins}}{\text{\# of games}}$; $\bar{x} = \frac{4290 + 110 + 140 + 115}{33 + 3} = \frac{4655}{36} = 129.3$

(Note: to find old # of games use formula $130 = \frac{4290}{x}$ and get 33)

5. $= \{40, 42, 44, 44, 45, 45, 47, 47, 47, 49\}$

a. mean : $\bar{x} = \frac{450}{10} = 45$

median : 45

mode : 47

b. new set: $\{^-5, ^-3, ^-1, ^-1, 0, 0, 2, 2, 2, 4\}$

the sum is 0.

Chapters 3 & 4, Lesson 9, Worksheet 6 (cont'd)

6. $= \{10, 12, 15, 17, 17, 19, 21, 25\}$

   a. mean : $\bar{x} = \frac{136}{8} = 17$

      median : 17

      mode : 17

   b. new set : $\{^{-}7, {}^{-}5, {}^{-}2, 0, 0, 2, 4, 8\}$

      the sum is 0.

7. The mean is defined such that the sum of the deviations from the mean will always equal zero. $\Sigma(x - \bar{x}) = 0$

Chapters 3 & 4, Lesson 10, Worksheet 7

1. 3
2. 527
3. 0
4. 2
5. 8
6. 6
7. $^{-}6$
8. $^{-}35$
9. 72
10. 8

11. F
12. T
13. T
14. T

15. done for you
16. $\{2.3, {}^{-}2.3\}$
17. $\{0\}$
18. $\emptyset$
19. $\{3, {}^{-}3\}$
20. $\{4, 2\}$

Chapters 3 & 4, Lesson 12, Worksheet 8

1. 18
2. 48
3. $18^2 = 324$
4. 0
5. 12
6. 8
7. 12
8. $2 \cdot 18 = 36$
9. $48 - 324 = {}^{-}276$
10. 72

11. 9
12. 119
13. 81
14. 23
15. $^{-}46$
16. $9 - 18 = {}^{-}9$
17. $18(9) = 162$
18. $48(119) = 5712$
19. $18 + 23 = 41$
20. $\frac{18}{81} = .\overline{2}$

Chapters 3 & 4, Lesson 14, Worksheet 9

1. 10
2. $^{-}8$
3. False
4. 8
5. 6
6. True

7. 2.65
8. = 8.2369
9. 2.11
10. $^{-}2.55$
11. = 57.4564
12. 1.42
13. = 3
14. = 2

15. 9.22
16. 4.36
17. 4.49
18. = 6
19. 5.23
20. 2.43

Chapters 3 & 4, Lesson 17, Worksheet 10

1. z-score 2. a. 58 b. 8 42 c. 2.3 18.4 18.4 68.4

2. d. 50 e. 38 3. Can't tell. Need to have some standard for comparison. 4. a. 2 1 b. Customer Service, His best score (relative to others taking these tests) was on the social interaction test.

5. True. If $z = 0$ then $x = \mu + 0 \cdot \sigma = \mu$.

6. No. A percentile rank of 60 is above the median score which has a z-score of 0. Therefore, a percentile rank of 60 will have z-score > 0.

7. Carol, Her score is 2 standard deviations above the mean. Sue's is only 1 standard deviation above.

8. $\sigma = 3$

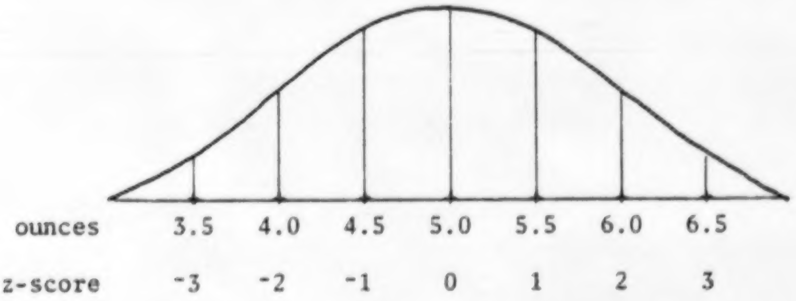
Chapters 3 & 4, Lesson 19, Worksheet 11

1. $z = {}^-1$ 2. ${}^-1$ 16 3. $x = 71$ 4. 84 98 84 98

5. 5'4" = 64" $z_{64} = {}^-2$ Therefore, ~98% of men are taller.

6. 14 + 34 + 34 = 82 There are ~82% of the men between 64" + 70".

7.


ounces
3.5
4.0
4.5
5.0
5.5
6.0
6.5
z-score
-3
-2
-1
0
1
2
3

8. When $x = 4$ oz. $z = {}^-2$ Therefore, there is a 2% chance someone will be served less than 4 oz. of meat.

9. When $x = 2.65$ oz. $z = {}^+1$ Therefore, there is a 16% chance of getting a candy bar weighing more than 2.65 oz.

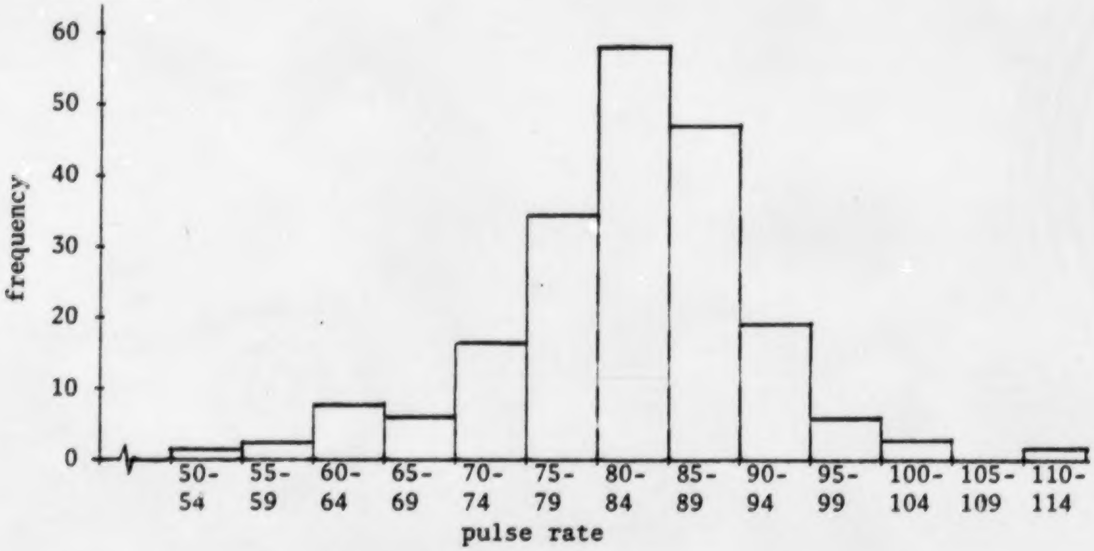
Chapters 3 & 4, Lesson 21, Worksheet 12

1.

PULSE RATE OF PATIENTS
AT HAWAII CLINIC

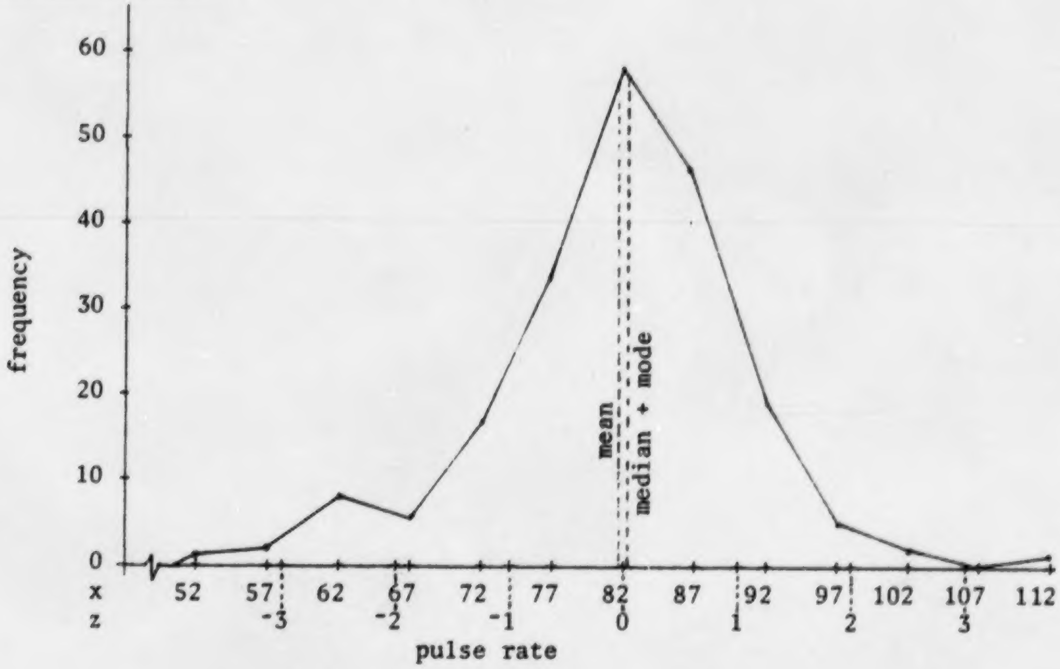
Pulse Rate	Class Mark	Tally	Frequency (F)	Relative Frequency	Cumulative Frequency (CF)	Cumulative % (C%)
50- 54	52	𝍷	1	$\frac{1}{200}$=.005	1	$\frac{1}{200}$= .005
55- 59	57	𝍷𝍷	2	$\frac{1}{100}$=.010	3	$\frac{3}{200}$= .015
60- 64	62	𝍸 𝍷𝍷𝍷	8	$\frac{1}{25}$=.040	11	$\frac{11}{200}$= .055
65- 69	67	𝍸 𝍷	6	$\frac{3}{100}$=.030	17	$\frac{17}{200}$= .085
70- 74	72	𝍸 𝍸 𝍸 𝍷𝍷	17	$\frac{17}{200}$=.085	34	$\frac{17}{100}$= .170
75- 79	77	𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍷𝍷𝍷𝍷	34	$\frac{17}{100}$=.170	68	$\frac{17}{50}$= .340
80- 84	82	𝍸 𝍸 𝍸 𝍷𝍷𝍷 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	58	$\frac{29}{100}$=.290	126	$\frac{63}{100}$= .630
85- 89	87	𝍸 𝍷𝍷 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸	47	$\frac{47}{200}$=.235	173	$\frac{173}{200}$= .865
90- 94	92	𝍸 𝍸 𝍸 𝍷𝍷𝍷𝍷	19	$\frac{19}{200}$=.095	192	$\frac{24}{25}$= .960
95- 99	97	𝍸	5	$\frac{1}{40}$=.025	197	$\frac{197}{200}$= .985
100-104	102	𝍷𝍷	2	$\frac{1}{100}$=.010	199	$\frac{199}{200}$= .995
105-109	107		0	.000	199	$\frac{199}{200}$= .995
110-114	112	𝍷	1	$\frac{1}{200}$=.005	200	$\frac{200}{200}$=1.000

2. Histogram

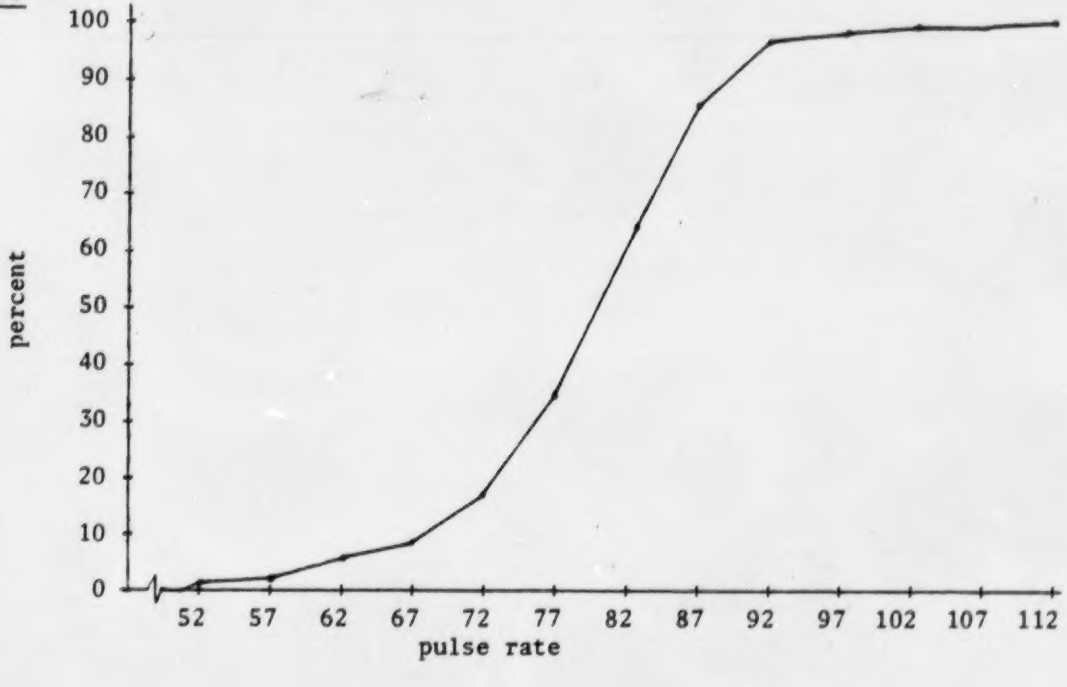


Chapters 3 & 4, Lesson 21, Worksheet 12 (cont'd)

Frequency Polygon



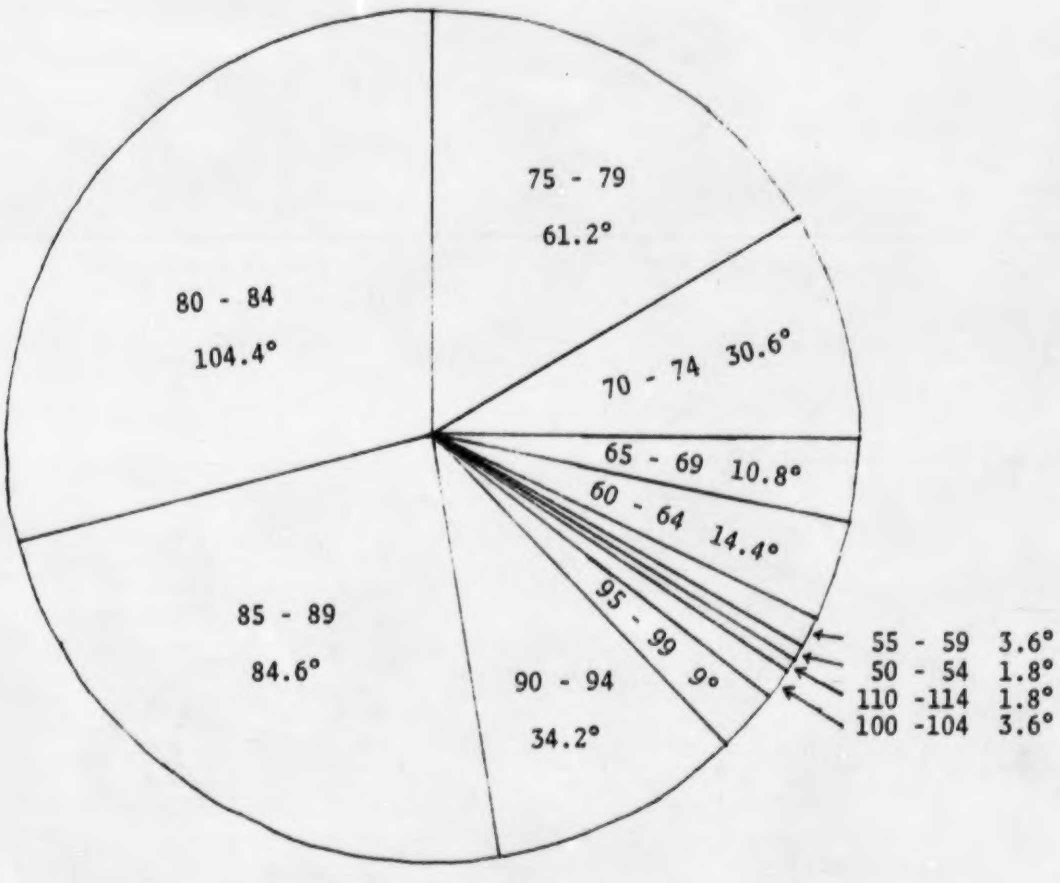
Ogive



Chapters 3 & 4, Lesson 21, Worksheet 12 (cont'd)

Circle Graph

pulse rate	relative frequency	degrees
50- 54	.005	.005 x 360 = 1.8°
55- 59	.010	.010 x 360 = 3.6°
60- 64	.040	.040 x 360 = 14.4°
65- 69	.030	10.8
70- 74	.085	30.6
75- 79	.170	61.2
80- 84	.290	104.4
85- 89	.235	84.6
90- 94	.095	34.2
95- 99	.025	9
100-104	.010	3.6
105-109	.000	0
110-114	.005	1.8



pulse rate of 200 walk in patients

Chapters 3 & 4, Lesson 21, Worksheet 12 (cont'd)

3.

x	y*	F	Fy	Fy^2
52	-30	1	-30	900
57	-25	2	-50	1250
62	-20	8	-160	3200
67	-15	6	-90	1350
72	-10	17	-170	1700
77	-5	34	-170	850
82	0	58	0	0
87	5	47	235	1175
92	10	19	190	1900
97	15	5	75	1125
102	20	2	40	800
107	25	0	0	0
112	30	1	30	900

* $y = x - 82$

Answers will vary depending upon the value of the constant.

4. Mean $= \dfrac{\Sigma Fx}{\Sigma F}$ Coded mean $= \dfrac{\Sigma Fx}{\Sigma F} = \dfrac{-100}{200} = {}^{-}.5$

therefore, actual mean $= 82 + {}^{-}.5 = 81.5$
Note: This is the approximate mean since the class marks were used rather than the actual data.

Median interval = interval which includes the 100th and 101st pulse rate. The frequency distribution shows that this interval is 80 - 84.

Modal Interval: 80-84

5. Range: 112 - 52 = 60

Variance: $\sigma^2 = \dfrac{\Sigma Fx^2}{n} - \dfrac{(\Sigma Fx)^2}{n^2}$

$$\text{coded } \sigma^2 = \frac{\Sigma Fy^2}{\Sigma n} - \frac{(\Sigma Fy)^2}{n^2}$$

$$= \frac{15150}{200} - \frac{10,000}{40,000}$$

$$= 75.75 - .25$$

$$\text{coded } \sigma^2 = 75.5$$

$$\text{actual variance } \sigma^2 = 75.5$$

$$\text{Standard Deviation} = \sqrt{\text{variance}}$$
$$= \sqrt{75.5}$$
$$\approx 8.7$$

Chapters 3 & 4, Lesson 21, Worksheet 12 (cont'd)

6. $x = \mu + \sigma z$

when $z = {}^{-}3$, $x = 81.5 + 8.7({}^{-}3)$
$x = 55.4$

when $z = {}^{-}2$, $x = 64.1$
when $z = {}^{-}1$, $x = 72.8$
$z = 0$, $x = 81.5$
$z = 1$, $x = 90.2$
$z = 2$, $x = 98.9$
$z = 3$, $x = 107.6$

7. 69.5%

8. $P_{16} \approx 71$ $PR_{82} \approx 85$
$P_{84} \approx 85$ $PR_{70} \approx 15$
$P_{97} \approx 95$

9. $P_{84} \approx 85$ when $z = 1$, $x = 90.2$

They're close. Maybe. (In a normal distribution $P_{84} \approx x$ when $z = 1$.)

Chapter 9, Lesson 1, Worksheet 1

1. a. positive b. positive c. negative d. negative

e. zero f. positive g. positive h. positive

i. negative 2. positive

3. More money often means more responsibility which might mean more headaches and higher blood pressure.

There may be no cause and effect at all. There may be a 3rd factor such as age that affects this result.

Chapter 9, Lesson 3, Worksheet 2

1. (a) 3.0 (b) 3.0 2. (a) 1.5 (b) 1.5

3. (a) 1.0 (b) 1.0 4. (a) 0.5 (b) 0.5

5. (a) positive (b) negative 6. a (it's less like a line)

7. answers will vary (positive) 8. answers will vary (negative)

9. answers will vary (positive) 10. answers will vary (negative)

11. 0

Chapter 9, Lesson 3, Worksheet 2 (cont'd)

12.

x	y	x^2	y^2	xy
4	2	16	4	8
3	3	9	9	9
2	0	4	0	0
4	3	16	9	12
1	2	1	4	2
5	3	25	9	15
$\Sigma=19$	$\Sigma=13$	$\Sigma=71$	$\Sigma=35$	$\Sigma=46$

13. 6

14. $6(46) = 276$

15. $19 \cdot 13 = 247$

16. $6(19)^2 = 6(361) = 2166$

17. $2166 = 361 = 1805$

18. $6(13)^2 = 6(169) = 1014$

19. $1014 - 169 = 845$

Chapter 9, Lesson 4, Worksheet 3

1. $r = \dfrac{5(6) - 0(5)}{\sqrt{5(10) - 0^2} \cdot \sqrt{5(11) - 5^2}} \approx {}^{+}0.775$

2. $r = \dfrac{6(66) - 28(6)}{\sqrt{6(232) - 28^2} \cdot \sqrt{6(46) - 6^2}} \approx {}^{+}0.597$

3. $r = \dfrac{10(84) - 50(22)}{\sqrt{10(340) - 50^2} \cdot \sqrt{10(63) - 22^2}} \approx {}^{-}0.717$

4. $r = \dfrac{6(213) - 24(44)}{\sqrt{6(366) - 44^2} \cdot \sqrt{6(136) - 24^2}} \approx {}^{+}0.889$

5. $r = \dfrac{7(56) - 0(42)}{\sqrt{7(28) - 0} \cdot \sqrt{7(368) - 42^2}} \approx {}^{+}0.983$

Chapter 9, Lesson 4, Worksheet 3 (cont'd)

6.

x	y	xy	x^2	y^2
0	1	0	0	1
1	0	0	1	0
2	4	8	4	16
3	0	0	9	0
6	6	36	36	36
7	3	21	49	9
21	7	147	441	49
42	20	840	1764	400
48	17	816	2304	289
75	24	1800	5625	576
$\Sigma x=205$	$\Sigma y=82$	$\Sigma xy=3668$	$\Sigma x^2=10233$	$\Sigma y^2=1376$

$n = 10$

$$r = \frac{10(3668) - 205(82)}{\sqrt{10(10233) - 205^2} \cdot \sqrt{10(1376) - 82^2}}$$

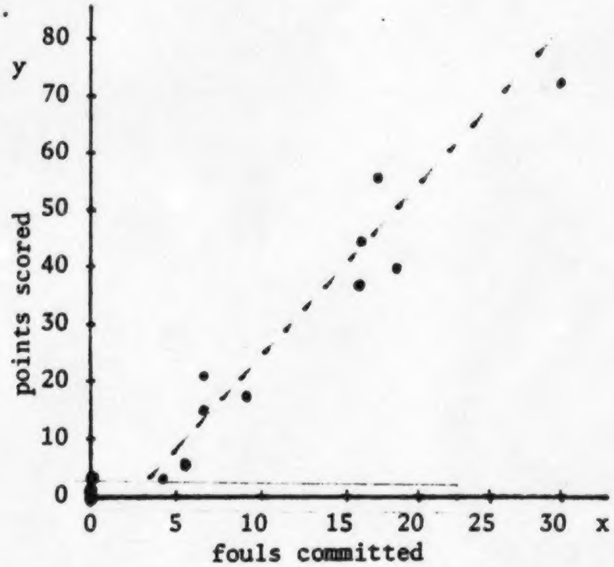
$$\approx \frac{19870}{245.57 \times 83.88} \approx {}^{+}0.965$$

Chapter 9, Lesson 7, Worksheet 4

1. a. negative c. ~65°F d. If estimated regression line is used, ~45°F. However, all data is between 40 and 90 and reliability of predicting much beyond this range should be questioned.

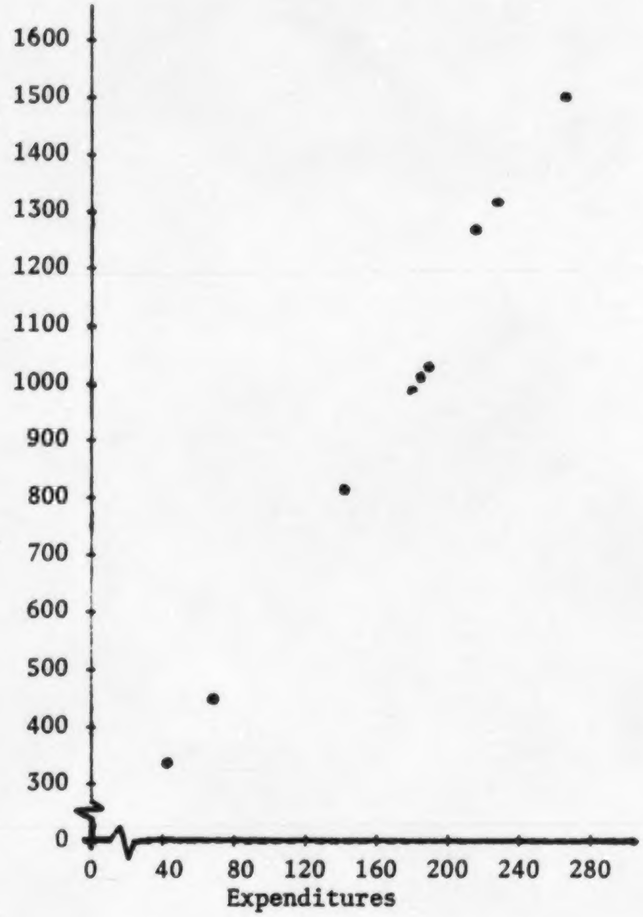
2. a. negative c. ~3:43 d. never, vary (Reliability beyond given range should be questioned.)

3.



Chapter 9, Lesson 7, Worksheet 4 (cont'd)

4.



a. $1100 b. 181,558 (184,100,000 ÷ 1014 ≈ 181,558)

Chapter 9, Lesson 9, Worksheet 5

1. a. 77.5 b. vary c. vary (Do crickets hibernate? At what temperature?)
2. 8th: $5600 high: $7200 College: $8800
3. b. vary c. 17.2
4. for prediction purposes

203

QUIZZES AND TESTS ANSWER KEY

Chapter 1, Quiz 1

Answers will vary.

Chapter 2, Quiz 1

1.

GRADES IN STATISTICS EXAM

Grade	Frequency	Cumulative Frequency*	Relative Frequency
A	9	50	$\frac{9}{50} = .18$
B	10	41	$\frac{10}{50} = .2$
C	20	31	$\frac{20}{50} = .4$
D	8	11	$\frac{8}{50} = .16$
E	3	3	$\frac{3}{50} = .06$

2. 21.5

3. 9 $\frac{86 - 15}{8} = 8\frac{7}{8}$, or 9 when rounded

4. 10 $56 - 18 = 36$; $\frac{38}{4} = 9\frac{1}{2}$, or 10 when rounded
(There is always an integral number of classes.)

5. $\frac{53 - 30}{8} = 2\frac{7}{8}$, or 3 when rounded ; There should be three integer values per class interval.

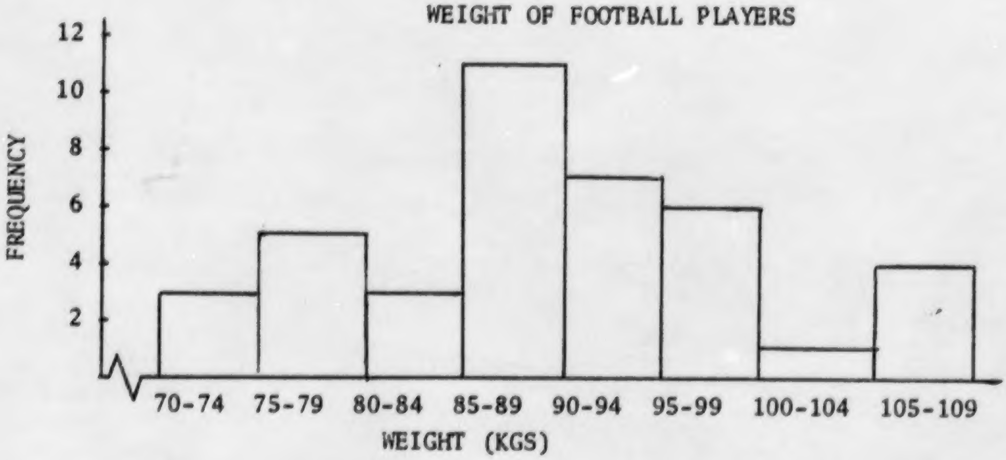
Class	Interval	Class Mark	Tally	Frequency	Relative Frequency	Cumulative Percent
1	30 - 32	31	𝍸 I	6	$6/50 = .12$	12%
2	33 - 35	34	IIII	4	$4/50 = .08$	20%
3	36 - 38	37	𝍸 IIII	9	$9/50 = .18$	38%
4	39 - 41	40	𝍸 I	6	$6/50 = .12$	50%
5	42 - 44	43	𝍸 I	6	$6/50 = .12$	62%
6	45 - 47	46	𝍸 I	6	$6/50 = .12$	74%
7	48 - 50	49	IIII	4	$4/50 = .08$	82%
8	51 - 53	52	𝍸 IIII	9	$9/50 = .18$	100%

Chapter 2, Quiz 2

1. a. 9
   b. 21
   c. 65

2.

Interval	Tally	Frequency
70 - 74	|||	3
75 - 79	𝍸	5
80 - 84	|||	3
85 - 89	𝍸 𝍸 |	11
90 - 94	𝍸 ||	7
95 - 99	𝍸 |	6
100 - 104	|	1
105 - 109	||||	4
		40



Chapter 2, Quiz 3

1. .3125

2. .08

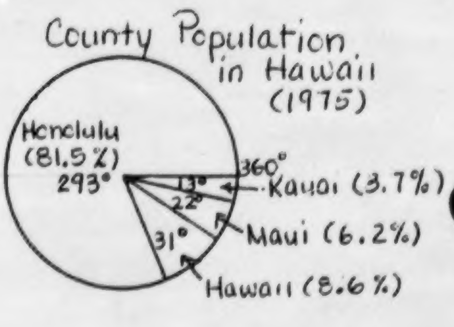
3. $33\frac{1}{3}$

4. 120°

5. .27 x 63 = 17.01 , Therefore, 17 people qualified.

6.

Relative Frequency	Central Angle Measure
$\frac{704500}{864900}$ = .815	293°
.086	31°
.062	22°
.037	13°



Chapter 2, Chapter Test

1. (Answers will vary) 2. True 3. True 4. False 5. False 6. True

7. False 8. d. 9. b. 10. a. 11. a. 12. c.

13a. Pictograph or Bar Graph or Cirlce Chart

13b. Pictograph or Pie Chart or Frequency Polygon

14. 15% 15. $315.00 16. 108 degrees 17. Histogram 18. 71

19. 1 mile 20. 11 21. $\frac{20}{71}$ or .282 22. $A = \frac{10}{50} = .2$

23. B = 17 24. C = 64% 25. 59

26. (Graphs will vary)

Chapters 3 & 4, Quiz 1

1. $\text{PR of } 41 = \frac{8 + \frac{1}{2}(3)}{20} \cdot 100 = 47.5$

2. $\frac{2}{20} = 10\%$

3. No. A score of 88% may be below the 80th percentile. More than 20% of the people taking the test may have done better than Tom did.

4. 25%

5. 65%

6. $B = 15$, $E = 2$, $PR = \frac{15 + \frac{1}{2}(2)}{20} \cdot 100 = 80$

Chapters 3 & 4, Quiz 2

1. mean

2. B. It's the most popular and will therefore sell the most.

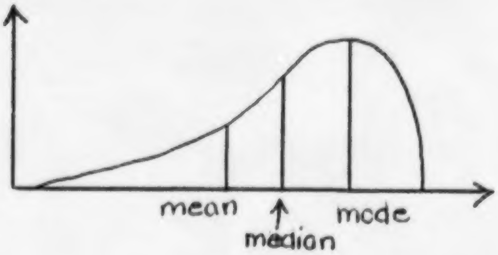
3. mean $= \frac{\Sigma x}{n} = \frac{44}{10} = 4.4$ median = 4 mode = 1, 3, 5 (tri-modal)

4. $\bar{x} = \frac{\Sigma x}{n}$ $8 = \frac{10 + 10 + 10 + 9 + 9 + 8 + 8 + 8 + 8 + 7 + 7 + 7 + 7 + 4 + \rule{2em}{0.4pt}}{15}$;

$$8 = \frac{112 + \rule{2em}{0.4pt}}{15}$$

Winona's score = 8

5.



6. All ten terms must be 1's.

Chapters 3 & 4, Quiz 3

1. True

2. Mode = 7

3. Median = 6

4. Mean $= \frac{64}{11} = 5.\overline{81}$

5.

Class Mark	x · f
2.0	10
2.5	25
3.0	36
3.5	35
3.9	11.7

$$\bar{x} = \frac{\Sigma xf}{\Sigma f} = \frac{117.7}{40} = 2.9425$$

6. one possibility : {5, 5, 5, 5, 5, 5, 5, 2, 2, 1}

Chapters 3 & 4, Quiz 4

1. 3 2. 6 3. 38 4. 36

5. Range = 27 - 15 = 12

6. Average Deviation = $\frac{\Sigma|x - \mu|}{n} = \frac{1 + 2 + 4 + 3 + 9 + 3 + 3 + 2 + 0 + 1}{10} = 2.8$

7. Variance = $\sigma^2 = \frac{\Sigma(x - \mu)^2}{n} = \frac{1 + 4 + 16 + 9 + 81 + 9 + 9 + 4 + 0 + 1}{10} = 13.4$

Chapters 3 & 4, Quiz 5

1. 36 2. 5 and 6 3. a. Range = $9 - (^{-}2) = 11$ b. Mean = $\mu = \frac{25}{5} = 5$

3. c.

x	$x - \mu$	$\lvert x - \mu \rvert$	$(x - \mu)^2$
8	3	3	9
4	$^{-}1$	1	1
9	4	4	16
$^{-}2$	$^{-}7$	7	49
6	1	1	1
		$\Sigma = 16$	$\Sigma = 76$

3. d. Average Deviation = $\frac{\Sigma|x - \mu|}{n} = \frac{16}{5} = 3.2$

e. Variance = $\sigma^2 = \frac{\Sigma(x - \mu)^2}{n} = \frac{76}{5} = 15.2$

f. Standard Deviation = $\sigma = \sqrt{\text{variance}} = \sqrt{15.2} \approx 3.90$

4. There is no deviation. $\sigma = 0$

Chapters 3 & 4, Quiz 6

1. standard deviations 2. 0 3. b) 10

4. $Z = \frac{x - \mu}{\sigma} = \frac{19 - 24}{3} = \frac{^{-}5}{3} = -1.\bar{6}$ 5. a. 62 min. b. 52 (62-10)

5. c. $\mu = 62$ and $\sigma = 6$ Therefore $x = 62 + 1.8(6) = 62 + 10.8 + 72.8$ min.

6. If $x = 1.00$ pounds, $z = ^{-}2$. Therefore, there will be ~2% of the boxes weighing less than one pound.

Chapter 3 & 4, Chapter Test

Part I.

1. J   2. K   3. C   4. B   5. G   6. F   7. I   8. E

Part II.

1. F   2. T   3. F   4. T   5. T   6. F   7. F   8. F

9. $^-2$ 10. 8   11. 8, 9   12. \$34.87

13. \$33.68   14. \$34.56   15. e.   16. d.

17. d.   18. c.   19. b)   20. d.

21. a.   22. $70.8\overline{3}$ 23. 25%

24. a) It has a narrower spread. Scores are more concentrated in one area.

25. 391.4   26. 6929.84   27. $z_{Mary} = 1.5$ $z_{John} = 1.2$ Mary

28. $20 \times 83 = 1660$ $25 \times 75 = \frac{1875}{3535} \div 45 = \boxed{78.5}$

29. 39 - 47   30. 48 - 56

31.

x	x^2	$(x - 10)$	$\lvert x - \mu \rvert$	$(x - \mu)^2$
6	36	$^-4$	4	16
9	81	$^-1$	1	1
10	100	0	0	0
12	144	2	2	4
13	169	3	3	9
$\Sigma=50$	$\Sigma=530$	$\Sigma=0$	$\Sigma=10$	$\Sigma=30$

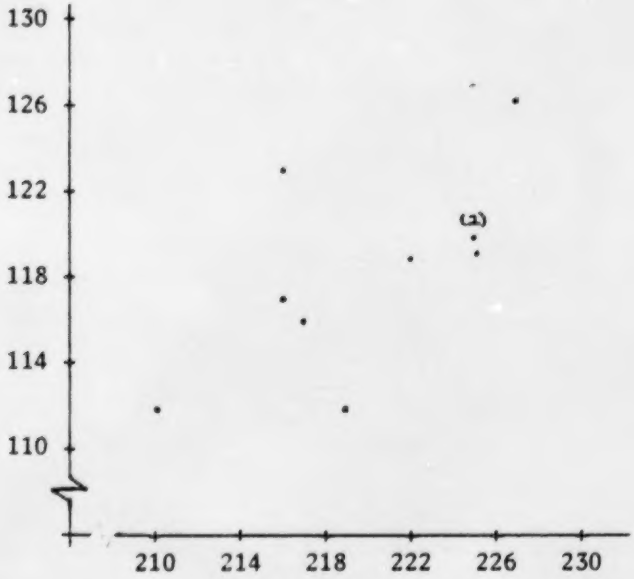
32. $\frac{\Sigma\lvert x - \mu\rvert}{n} = \frac{10}{5} = 2$ 33. $\frac{\Sigma(x - \mu)^2}{n} = \frac{30}{5} = 6$

34. $\sqrt{\text{variance}} = \sqrt{6} = 2.45$

Chapter 9, Quiz 1

1. b) 2. a)

3.



vary (positive)

4. $r = \dfrac{9(70) - 30(15)}{\sqrt{9(128) - 30^2} \cdot \sqrt{9(43) - 15^2}} \approx {}^{+}0.89$

5.

x	2	7	3	8	4	1	1
y	1	3	2	3	2	1	0
xy	2	21	6	24	8	1	0
x^2	4	49	9	64	16	1	1
y^2	1	9	4	9	4	1	0

$\Sigma x = 26$
$\Sigma y = 12$
$\Sigma xy = 62$
$\Sigma x^2 = 144$
$\Sigma y^2 = 28$
$n = 7$

$r = \dfrac{7(62) - 26(12)}{\sqrt{7(144) - 26^2} \cdot \sqrt{7(28) - 12^2}} \approx {}^{+}0.929$

6. b)

Chapter 9, Chapter Test

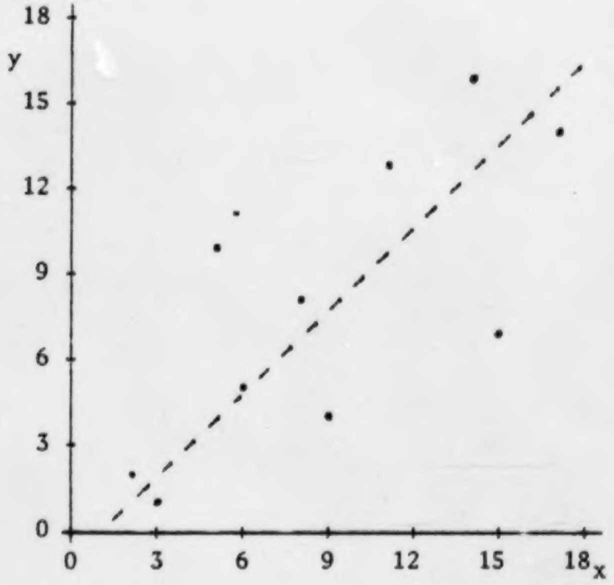
1. T 2. T 3. T 4. F

5. F 6. $^{-}.3$ (will vary) 7. b) 8. d)

9. e. 10. b. 11. a. 12. $^{-}2.2$

13. $r = \dfrac{10(897) - 90(80)}{\sqrt{10(1050) - 90^2} \cdot \sqrt{10(880) - 80^2}} \approx {}^{+}0.7375$

14. and 15.



16. $^{-}9$

Final Exam

1. True 2. b. 3. Yes (Fewer accidents than who?)

4. $\frac{37}{65} \approx .569$ 5. $\frac{14}{65} \approx .215$ 6. $\frac{23}{65} \approx 35.4\%$ 7. 120° 8. 33.5

9. c. 10. mean, median, mode 11. 27 12. 8

13. median, Mode doesn't reflect all scores and mean influenced by extreme values ($950 and $1500). 14. 25 15. Lautoa

16. P.R. $= \dfrac{5 + 1/2(1)}{15} \cdot 100 = 36.\overline{6}$ 17. histogram 18. 57

19. 17.5% 20. 4.95 - 6.95 21. not enough information 22. median

22. median 23. b. 24. d. 25. True 26. $^{+}1.00$

27. negative 28. $r = {}^{-}0.8$ 29. $y^1 = 24$ 30. $^{-}190$ chirps/minute

Final Exam (cont'd)

22. median 23. b. 24. d. 25. True 26. $^{+}1.00$

27. negative 28. $r = {}^{-}0.8$ 29. $y^1 = 24$ 30. $^{-}190$ chirps/minute

31. to predict outcomes given a set of relations